

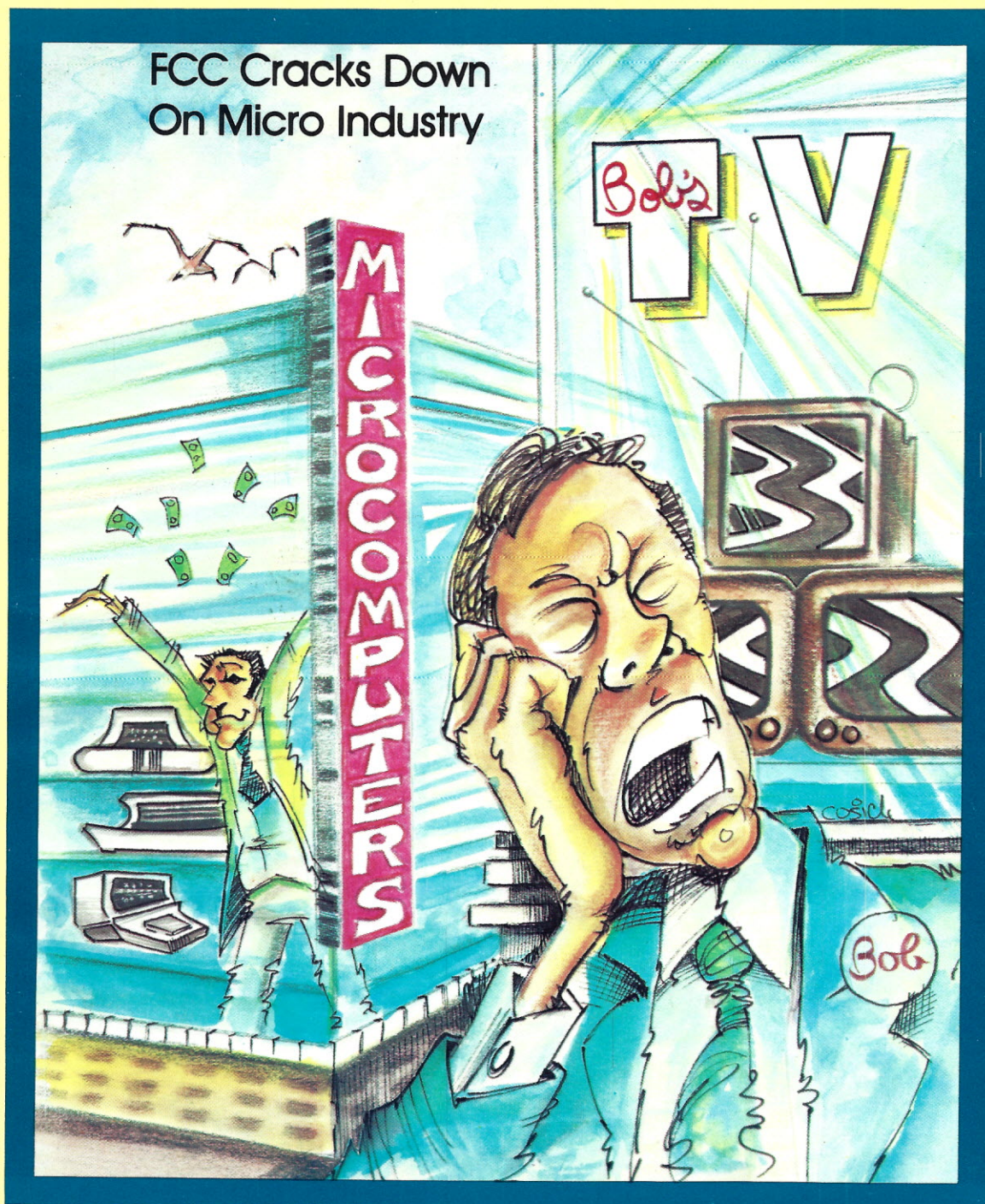
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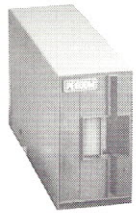
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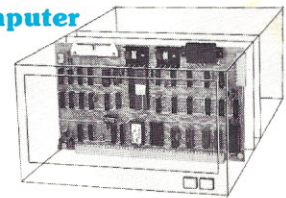
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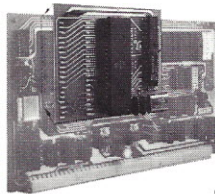
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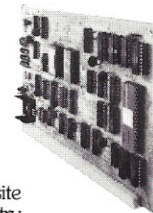
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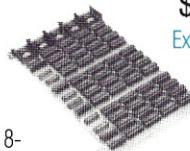
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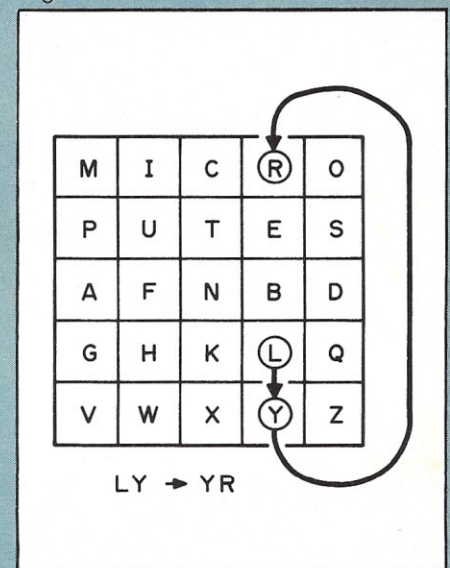
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## This month:

You can always tell when a fledgling industry has finally made the big time: the Federal Government finds a way to regulate it. Sure enough, it's happened to the microcomputer industry in the form of regulations governing radio frequency interference (RFI).

In this month's cover story ("FCC Takes Aim Against RFI Polluters"), we examine the Federal Communications Commission's rules on computer-generated RFI, delve into the history of the RFI controversy and explore the ramifications of the new regulations on both manufacturers and users. There are many questions to be considered.

Why, for instance, are the RFI regulations for microcomputers many times more stringent than for minicomputers and mainframes? Why are some major firms meeting the RFI regulations with ease, while others struggle to meet already extended deadlines? And what about the smaller firms making peripherals and accessories? Can they cope with the FCC's costly RFI certification mandate?

It may be tempting to believe that we, as microcomputer users, need not concern ourselves with the problems of manufacturers. Unfortunately, things are more complicated than that. We may find that as a result of the RFI rules, our micros will become more costly and less flexible than in the past. But judge for yourself; the story begins on page 30.

—The Editors

## Next month:

*Kilobaud Microcomputing* will explore the world of word processing in next month's issue. You'll examine the many software systems available to turn your computer into an efficient word processing machine and discover new applications as some of our readers share their word processing experiences.

## This month's cover:

Illustration by Richard Cusick.

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## Short-lived Computer Games



### Ballyhoo

Having just returned from another visit to the biannual madhouse known as CES (Consumer Electronics Show) in Las Vegas, I thought you might like to know what you missed: not much.

I thought the single outstanding event was the showing of the new television set by Panasonic. The darned thing is about the size of a pocket calculator, complete with an LCD screen about two by three inches. The picture wasn't very good, but it *was* there. It could probably be used as a screen for a pocket computer.

Other than that, microcomputer enthusiasts were hard put to experience much joy. Commodore showed their new color system, the VIC-20, which was indeed impressive and may have Radio Shack going back to the lab to increase the performance of their color system. But I got the impression that Commodore was thinking largely in terms of games, though giving some lip service to business applications.

Atari was there—complete with a very nice buffet—to express their hopes for the future. Again it was games and more games, with a mention of business. The Bally exhibit was almost totally game-ridden, as was the Mattel exhibit—identical to their showing in Chicago at the summer CES. I can understand the thinking which is involved here. Both Atari and Bally have come from the arcade-games business and are used to people plunking down substantial sums of money to play computerized arcade games. But I am wondering just how long this enthusiasm will continue.

While I admit that I can't hold myself up as a typical games person, I enjoy playing games in an arcade as much as the next guy; I flick in the quarters and jump around yelling as loud as anyone. But then when I get the same game set up at home, the thrill goes out of it in a matter of a couple of days. Perhaps having the game at home is like sex in marriage, which seldom has the excitement of the pre-marital chase.

The fact is that I am far more, not less, into games than most people. I will drop everything when *New York* magazine arrives so I can tackle their damned crossword puzzle. I love cryptograms and use my Casio wrist watch to time my solutions. I enjoy the Master-Mind-type of puzzles and time my solutions to those, too. All my life I've enjoyed card games, and I'm very good at them. I have yet to find anyone who can beat me at Cribbage.

One of the things that makes me difficult to beat—besides a developed sense of conniving fiendishness needed to win by wits—is my consistent luck. This luck holds true not only in games, but in life too. Oh, I've had some heavy traumas, but each of them came from putting my trust in people, not in having bad luck. I would be hard put to attribute any serious problems to luck, or lack of it.

I developed this interest in games early in life because my whole family was game oriented, and most evenings were spent in playing card and board games. Still, with all this gamey background, I find that computer games bore the hell out of me in a few hours, no matter how much fun they are at first.

There is no shortage of remarks in the papers about the short life of the early television games when brought into the home, and we've found the same thing with our computerized games. We seem to get much of our enjoyment of games from their novelty, from being out in public and perhaps even from paying for them.

When I first became interested in computers, I was dying to have a real chance to have at Hammurabi and Star Trek. Hammurabi lasted about two days, and Star Trek perhaps four, before I became bored. I've never played either of them since. They are as important to me as the paddles, which are gathering dust under the TV set, and the mock rifle for shooting TV targets. I had fun with those for maybe a week before putting them up permanently.

Is there any reason why even the great

games now available on the Bally, Mattel and Atari computers are going to last more than a few days before boredom sets in? And what comes next? Is it possible that this boredom with these incredibly expensive toys won't be considered news by newspapers and magazines, in turn scuttling sales for the game purveyors? I'd be surprised if *The Wall Street Journal* hasn't already lined up its sights on this fat target. And you know that *Money* and a few other magazines will be hitting hard. *Fortune*, where are you?

Has anyone seen a study showing that these expensive computer games last any longer with users than the old home pong games? Playing stickman baseball or soccer is *not* the same as watching a game on TV, and I predict that unless the game people start reviewing their situation, we may be heading for another round of disasters. We've watched the mighty fall by misreading the market, and have seen Mits, Imsai, Processor Tech, The Digital Group, etc., go down the tubes.

Is there any way for all of these game-oriented firms to start hedging their bets? I realize that it is difficult for the entire top management of firms that have made millions on arcade games to even momentarily consider the possibility that home computer games will not be as lastingly popular as arcades, but this may be a thought which has to be thought.

What can they do? One of the best bets is to sit down and talk with some industry consultants—people who are not brainwashed by arcade successes, but who have some perspective on the microcomputer industry, where it started, where it traveled getting to where it is now and where it may be going. Then the trick is to evaluate the hardware available and see what, if anything, can be done to start hedging bets, if this seems prudent.

Yes, there is going to be a big business market, but can the Bally computer adapt to it? And, yes, there is going to be a huge educational market, which may also be difficult to cope with. And eventually there is going to be some kind of a



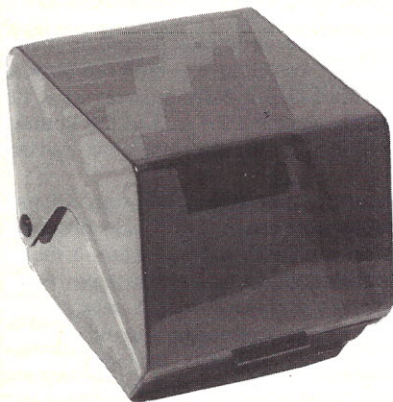


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 sales tax.



home market, but how soon, and what will it really be like? And then, are the Mattel and APF aimed right for it? I think I have some good answers to the above questions, as do a lot of other chaps I know. But I'm not going to give them away for \$2.95, and neither is anyone else.

The Apple people, not having the arcade background, perceived the dangers of depending on games for an extended success and have been working towards getting into the business market with their system. The Apple II was almost entirely a game machine, so the attempts at billing it as a business system didn't ring very true, despite the nice ads to the contrary. The color was part of the problem. Business computers are black and white (or green), not in full color. I don't think anyone at Apple thought of this, so when business applications were promoted they, too, were in color, and this made it difficult for businessmen to take them seriously.

There certainly are uses for color in business programs, but I suggest that the shrewd programmer remember the black-and-white syndrome and use that except where color is really called for. Color can be used to emphasize something, such as an account that is past due. It can indicate the status of an inventory item for quick spotting by the operator. It can also indicate a changed item or new part number.

I predict that there is enough need for color so that all business systems will eventually have to have it. From that viewpoint the change in chip by Radio Shack for their color system is indeed unfortunate for them. This means that the wealth of programs written for the TRS-80 are going to be difficult to convert for use on their color system. The faster-acting machine-language programs are going to have to be rewritten, virtually from scratch. I don't think Radio Shack saw anything but the need for a game system to compete with Bally, Mattel, Atari, Commodore, etc., so they may have not given much consideration to the longer-term needs of the new system.

## Blitz Schools

Although it has been almost 40 years since I entered college, the trauma is still very much alive in my memory. In those days—just after the depression of the 30s—it was a completely accepted dogma that anyone who could afford to went to college. In retrospect, I managed to almost totally waste four years of my life.

My high school tried very hard to be helpful. They brought in professionals to administer aptitude tests to make sure that their graduates were heading toward a career which was best suited to them.

The high school I attended was Erasmus Hall in Brooklyn. It was a large,

**I predict that there  
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have to have it.**

but fine school at the time. I was dismayed to see a TV program about it the other evening and find that it is now considered the most dangerous school in New York. What a change! We had about 10,000 students and an after-school bunch of activities which made it superb. The school had over 100 different clubs for us to join, each meeting after school.

Each student was given a voice test when entering the school, and the top 100 voices were permitted to join the choral club. Meetings (rehearsals) were during the second period daily, so the group was an extraordinary choral group. The club gave concerts all around New York and was justly famous. Having started singing with a nearby church as a boy soprano, my voice had developed into a good baritone and I got to join this select group.

In addition to that I also was a member of the Savoyards, a group which met one day a week to practice Gilbert & Sullivan operettas. We put on *The Mikado* before the assembly—a frightening experience with over 7,000 in the audience. As an amateur radio enthusiast, I also joined the school's radio club and helped to operate and work on their ham station, W2ANU. It was one of the longest-lived ham clubs in the country at the time. Then there was the camera club, the book club, the music appreciation club, etc. I was a real joiner. As the current president of the Peterborough Chamber of Commerce, I guess I still am.

What a shame that Erasmus had to go from one of the most beautiful and wonderful of schools to an armed camp, with police needed in all of the halls to prevent mayhem, extortion and drugs. Pity.

My high school aptitude tests showed that I had an enormous mechanical talent. This, coupled with my ham license, indicated that I should be going to a technical college. Having been born in New Hampshire, I had intended on going to Dartmouth and perhaps getting a law degree. But, since my grandfather had become a millionaire in the 20s as an inventor (but subsequently lost everything in

the stock market crash in 1929), the results of the tests did not surprise me. I expected heredity to count for something.

I looked over the technical schools and picked the one that seemed to offer the most. It dated back to 1824 and had an excellent reputation. It was awful.

I found myself taking a series of courses which required sheer memorization and no practical application of concepts. This method of study results in a quick loss of concepts learned, without some practical use to reinforce the concepts. Everyone else at the school was in the same position—able to remember little of any course already passed. In many courses, I would have to read the book at night and face a daily quiz on what I'd read. By the time I'd passed the course, all I had left to show for the effort was the grade.

When I was halfway through college, the Japanese made the mistake of screwing around with Pearl Harbor. I found that it was not going to be a simple matter to stay in school. The draft was getting hotter, and I really didn't want to learn about trench warfare. I made contact with a naval commander who was running a research lab in Anacostia, across the river from Washington. He was interested in my ham background and wanted me to join the Navy so I could get into his lab. That sounded OK to me, and certainly better than the pot luck the Army had to offer, so I joined the Navy the day before I was to be inducted into the Army. That was a close call, and one of the better moves I've made in my life.

Before working in the lab, I had to get some background in radar, so I was given a third-class radio technician rating and sent to the Bliss Electrical School in Tacoma Park, on the outskirts of Washington. This was a three-month intro to electricity and radio. I graduated second in my class as a result of my ham background.

The next step was a six-month course in radio and radar at the Radio Materiel School at Treasure Island in San Francisco. This was a superb school, and I learned more about electronics in the six months than my college managed to teach in four years. They had practical courses in theory, followed by lab experience to make sure the theory sunk in and was practical. Every instructor was a ham, and I quickly went from just having a hazy concept of electronics to being able to work with anything electronic with full confidence. Just hand me a schematic and let me at it.

At the end of the school I had to make a tough decision. Should I follow my original plans and go to the lab in Anacostia or should I go to sea? Going to sea had several benefits for me. If I picked the right sort of ship I would be in charge of the electronic equipment and not have a daily ration of orders to follow. I do not do well when ordered, preferring to be asked—a



system which had not yet been discovered by the armed forces. One of the reasons I became an entrepreneur was that I work much better when I am the boss. The Navy had two spots which looked the right size for me—destroyers and submarines. With the food and pay being better on subs, I went that route, being a lover of good food and good pay.

The Navy responded to my request for submarine duty by asking if I preferred Atlantic or Pacific duty. Since my folks lived on the east coast, I opted for the Atlantic, and quickly found myself on a heavy cruiser (the Baltimore) heading for Hawaii. Not long after that I found myself in charge of the electronic equipment on a submarine. In retrospect, I think that I probably couldn't have found anything which I would have liked better.

I spent most of the rest of the war helping to sink Japanese ships (we ran up a very nice score). My sub, the USS Drum, SS-228, is now on display at Mobile, next to the Alabama, where our crew gets together every year for a reunion.

Once the war was polished off I went back to college for more memorization. This was a particularly bitter pill because I'd been through the Navy school and knew how good a school really could be. This whole thing has festered with me over the years, and it came to a head when I began dickering with the presidents of three nearby colleges about the introduction of microcomputer courses. Much to my surprise, I found that these college presidents all agreed with me that memorization is a waste of time.

As I talked with these people, an idea began to develop. What about setting up a college of my own which would concentrate on graduating computerists in a relatively short time? Perhaps an 18-month cram course similar to the one I'd had in the Navy. Students would work ten to twelve hours a day, six days a week, with no vacations, no dances, no soccer teams and no beer busts.

The computer industry is desperate for trained people, as a look at the want ads in the papers will confirm. The *Boston Globe* has virtually a whole section devoted to ads for computer people to help the myriad of firms around Route 128 expand. Wang has set up its own college course to help train people.

By working hard, we could teach the fundamentals of computer hardware, the elements of several languages and concentrate on BASIC and machine language for micros. To round out the education, I would add courses in business such as business law, contracts, personnel selection and management, advertising, sales, marketing, credit, bookkeeping and accounting.

By having the classes followed by lab work—and then by taking on much of the work now being done by the Instant Software people—each student would get a good deal of practical business experi-

ence as well as theory. Each graduate would also have a much better resume to offer right out of school by virtue of this practical experience.

The students would be encouraged to write specialized programs, which would then be produced and sold by other students, with royalties to the authors. This income would help pay for the schooling.

The hardware lab would not only teach how to repair all of the micro systems, how to interface anything to anything and how to adjust disks and printers, but would also teach the design of hardware for production by the industry, on a royalty basis.

The idea seems practical, lacking only the management and a campus with buildings. We're working on that aspect of it now, and the prospects seem bright.

### How to Become an Expert

One of the best ways to become known in the microcomputer field, and thus share in the juicy consulting fees which are available, is to establish yourself via articles published in *Microcomputing*. It may not exactly be a "publish or perish" situation, but it is a "publish or have to work" field.

What should you write about? For starters, why not tackle that aspect of the field which you know best? You'll not only attract more interested readers, but you'll also be on safer ground and save yourself from a lot of embarrassment. Keep in mind that the two major areas for expected development of micro sales lie in the business and educational uses of the systems. Thus, if you have some experience with micros in either of those applications, you may have the makings of an article, or several articles.

There is so much to be written that it is difficult to set up any restrictions. Businessmen are in desperate need of information about what systems, using what software, can solve their problems, cut their costs, increase their efficiency or enable them to provide more and faster service. Educators want to know about the uses of micros in the classrooms, their uses for CAI, the development of student programming, etc. If you've been involved in a project where micros have been brought into a school, there are a lot of people who are interested to learn about your problems and the end results, if any.

On the more technical end, there is a need for articles aimed at newcomers to computing which explain the various types of printers, the many disk systems, the pros and cons of each and how they can be used. Cassette systems should be covered thoroughly, probably in a series. Modems, music accessories, reviews of your experiences with new commercial products that might be useful to others—the list is endless. □

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## VIC-20 Debuts

## PET/CBM-Compatible Low-Cost Color Computer

### Commodore's Low-Cost Color Computer

The VIC-20 (video interface chip) was finally unveiled on January 18 at the Consumer Electronics Show in Las Vegas. It was first demonstrated and released in Japan, where over 1000 orders were taken in the first day of sales. Previously, there were many conflicting rumors concerning the keyboard size, system features and whether or not the unit would be compatible with the current PET/CBM models. Well, good news.

The \$299 VIC-20 features a full-sized typewriter keyboard and standard PET BASIC with the familiar screen-editing capabilities. The keyboard even includes eight programmable function keys that can be assigned any BASIC command or instruction set under program control.

System peripherals include a low-priced tape cassette unit, single floppy-disk drive, printer and a broad range of other add-on accessories to custom-tailor the system. I should point out that there is normally no IEEE interface without an added IEEE interface module. The peripherals normally connect through a special serial interface to the VIC-20

(similar to the way Atari interfaces its peripherals), so there will be disks and printers that contain the new interface. You can, however, use an existing PET/CBM cassette tape unit with the VIC-20, or you can use a new lower-cost unit.

The entry-level 5K RAM can be expanded by the use of various RAM (8 or 16K) and/or ROM cartridges to a maximum of 32K. The total add-on memory of any type cannot exceed 27K. Additional special features include an RS-232-C serial interface, joysticks, paddle controllers, light pen, sound and color graphics.

The screen display is normally formatted as a 506-character display, with 23 lines of 22 characters. Graphics resolution is 176 by 176, or 30,976 pixels. Color is selectable for characters, the screen background and border by simple BASIC POKE commands. There are 16 screen colors and eight border colors to choose from in any combination.

Special application programs and games will be available on plug-in ROM form, as well as on tape and disk. Some of these programs will be designed by Commodore programmers, but the majority will come from outside software developers. Commodore is actively seeking good

software for the new VIC and has several methods of paying for any software that is used.

Would-be software developers can develop software on the PET/CBM and "down load" to the VIC as long as certain program restrictions are observed. Obviously, no ROM-dependent programs will work, and you should keep in mind the difference in screen size. Commodore will be offering a software development kit that will include necessary hardware and documentation for the development of VIC software in ROM cartridges. I'll keep you posted on any new developments.

### More News from Commodore

In light of the tragic fire at the MGM Grand Hotel in Las Vegas during the Comdex 80 Exposition, Commodore has announced the availability of a disaster/emergency plan computer application program. This program will be released to all Commodore dealers. Documentation on Commodore's experiences during their assistance at the Las Vegas fire will also be included. Hopefully, Commodore dealers can then assist all local disaster relief organizations within their area in the event of any future disasters.

Commodore recently announced a new game package titled Galaxy One, which is available on diskette for \$49.95. The package includes 24 programs; some previously sold on tape for \$8 or more per program. Most of the games are excellent programs with good graphics. Certainly a good bargain for any serious game player. Here's a list of the games that are included:

Lunar Landing	Awari
Jumbo Jet Lander	Wumpus
Concord Lander	Othello
Glider	Super 9x9
Spaceflight	3D Tic-Tac-Toe
Galaxy Games	Backgammon



The Commodore VIC-20 color computer connects to any television set and comes complete with 5K memory (expandable to 32K), sound, graphics and full-size typewriter keyboard.

Robert W. Baker, 15 Windsor Drive, Atco, NJ 08004.



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In January Jack Tramiel was appointed Vice Chairman of the Board and Chief Executive Officer for Commodore International Limited. His prior position of President and Chief Operating Officer has been filled by James Finke, formerly Data General Corporation's Vice President and General Manager-Europe. This is the latest in a series of major organizational changes in recent months, as Commodore tries to gain a better position in the American market.

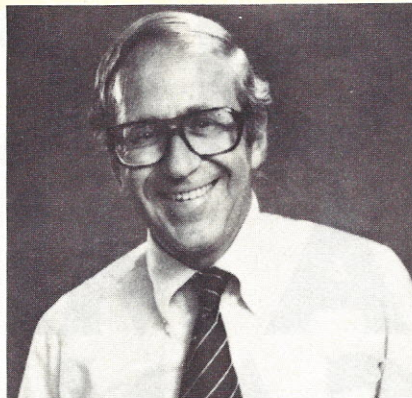
## Supersort

Programma International (2908 N. Naomi St., Burbank, CA 91504) is now distributing a machine-language sort program for the PET that was written by Jim Strasma. It's a general-purpose sort utility that takes up less than 1200 bytes at the top of memory. The program works with all current PET BASICs and adjusts to any memory size as it loads. It will not destroy other programs (like DOS 4.0) that have been loaded into high memory. To give you some idea of its speed, Supersort can sort an array of 3000 integers in less than 30 seconds. Try that in BASIC!

You can sort any BASIC string or integer array in ascending or descending order. Arrays can be one- or two-dimensional, and sorts can be specified on any desired field in the second dimension. Additionally, you can subsort other fields when a match is found in the prime sort field. The subsort fields do not have to be in any special order. The fields themselves can be random in length, and no special delimiters are needed. Other options allow sorting by bit mapping, with eight categories per byte. You can even limit sorts to a part of an array if necessary.

The options are set with simple POKE statements prior to calling Supersort via an appropriate SYS command. Convenient default settings are provided for each option. The command area used to pass parameters to Supersort consists of 13 bytes in the second cassette buffer, starting at decimal location 887. This area avoids parts of the buffer used by BASIC 4.0 and DOS 2.1. The command locations are used to indicate the array name, the sort field number, ascending or descending sorts, subsort on matches, bit matching and the matching pattern and/or limited sorts.

During the sort operation, the 44 locations after 886 in the second cassette buffer and the first 44 locations in page zero are exchanged. At the end of the sort, they are restored again. This speeds the sort by allowing shorter machine-language commands using the special zero-



*Commodore's newly appointed vice chairman of the board and chief executive officer, Jack Tramiel.*

page addressing modes of the 6502 microprocessor. It also protects BASIC from the sort and vice versa.

Sorting only part of an array can really speed things up drastically. Typically you dimension a large array, since arrays cannot be redimensioned without losing data. However, much of the array is usually empty or unused. You can tell Supersort where the real data ends and save up to 90 percent of the usual sort time.

With partially filled integer arrays it is essential to use this option because empty integer arrays are filled with zeros. If sorted, the null entries will be placed among the valid zero elements destroying the array validity. In string arrays, the elements of the array are initialized as null strings. Supersort puts null string elements at the top of the sorted array, effectively keeping unused elements away from user data.

The bit matching option takes a little time to understand if you're not used to machine-language programming. It logically ANDs a specified byte within the key field with a selected pattern, which can be any single byte value except zero (1 to 255). If a simple pattern is used many elements can match it. Subsorting can then be used to distinguish these from one another. The primary use of bit matching is to find all data elements that have something in common. You typically define several single-bit flags to identify various global categories or classifications. The bit matching can then be used to find all elements of a particular class or a particular combination of classes.

When errors occur within Supersort, the program sets the normal BASIC status variable (ST) to indicate the detected error. Thus, you can test the value returned in ST to determine if a sort has been accomplished successfully. After an error is indicated, the Supersort command locations in the second cassette buffer are not erased or changed. This allows you to inspect them from the PET monitor, or by peeking from BASIC, to determine the problem. All command locations are normally set to zero after a

successful sort. If you should cause an error condition that the program doesn't detect or protect against, the STOP key is still enabled allowing you to terminate execution.

With all the experimenting I've done with this program, I found it to be an excellent utility and apparently "bullet-proof." I did not encounter any unexpected or unexplainable situations. Complete documentation, along with a very enlightening demo program, is provided. The program is a worthwhile investment if you do any kind of data manipulations. Why reinvent the wheel, when you have this handy sort program? You can obtain a source listing from Jim Strasma (120 West King St., Decatur, IL 62521) for an extra \$10 once you've purchased a copy of Supersort.

## Massage and Recover

Last month I reviewed several utility programs from California Software Associates, PO Box 969, Laguna Beach, CA 92652, but only mentioned their Massage and Recover programs. At that time I was not able to load the sample copies due to a bad diskette. I received a replacement disk just after the last column went to print, so I thought I would give more information on these interesting and useful utilities now that I've been able to try them. You may want to refer to the disk format information that appeared in the September 1980 PET-pourri column.

Massage is a disk utility program for the 2000 series PET/CBM systems and disk drives (with the old DOS 1.0 ROMs) written in BASIC. The program can display and edit any diskette block, display and trace sequential or user files, trace block chaining, map the diskette BAM or rename the diskette. When the program is run, a simple menu lets you select the desired function by a single key-letter.

Before giving more information on each function, I should warn that Massage must be used with extreme caution since it allows arbitrary editing of a diskette without safeguards to protect DOS formatting. Edits to the block link pointers, the diskette BAM or the diskette directory could destroy an existing file if not made correctly. The authors suggest that you get used to the program on a scratch disk before trying it on any disk containing valuable information.

However, Massage is quite easy to use, and most mistakes are reversible as long as you can remember what you've changed. A handy appendix is included in the documentation with details on the DOS/diskette format.

**EDIT BLOCK (E).** When this function is selected, the program prompts for the desired drive, track and sector number. When the drive number is entered, the program accesses the disk and displays the disk name and ID for verification that the correct disk is about to be edited.



When entering the track and sector numbers, only valid combinations are accepted.

Once the necessary information has been entered, the program displays the block link pointers and waits for a RETURN to continue, S to stop or E to edit the line pointers. A track pointer of zero indicates the last block in a chain, and the sector pointer will then indicate the last-used byte of the block.

When you continue, Message takes a few seconds to read the block, then displays the block contents and asks whether you want to edit, print, stop or go to the next page. The screen display is organized as four pages of the three 20-character columns and one page containing one 16-character column. Each column has a reverse field entry indicating the byte number followed by the decimal value of the byte and the ASCII character it represents (if a printable character). The hard-copy output is organized horizontally for convenience.

If you choose to edit the block, the program first asks for a byte number. Responding with RETURN allows a "multi-byte" edit, and you are asked for the starting and ending byte numbers. A maximum of 20 bytes can be edited at one time. After specifying the byte(s) to be edited, you then enter the ASCII character (or string) to be entered.

For nonprinting characters, entering RETURN then allows you to enter the decimal byte value to be entered. If you were performing a multi-byte edit, the same number is repeated throughout the range when a nonprinting character is entered. To help protect against accidentally destroying the disk contents, the edited block is not written to the diskette until you give the STOP command and complete the edit.

**DISPLAY FILE (D).** This function displays or prints the record number, track, sector and pointer (starting byte) of each record of a selected sequential or user file. Optionally, the record contents can also be displayed or printed. Various controls are provided to suspend or terminate printing. At the end of the file or when told to stop, the program indicates the total number of file records, blocks and bytes up to the point of stopping.

**MAP DISK (M).** This function displays or prints all directory entries on the diskette. It indicates the filename, file type, total blocks, total bytes, starting track and sector and the directory track, sector and byte. Following the directory information, the diskette block availability map (BAM), number of file blocks, directory blocks, allocated blocks (allocated, but not in sequential or user files) and the total blocks used can also be displayed.

**TRACE LINKS (T).** This function will trace the block chaining of a selected file or starting track and sector. It displays or prints the indicated links until finding the last block of the chain, and indicates

the total number of blocks and bytes in the chain.

**UPDATE BAM (U).** This function allows you to allocate or free individual sectors on any diskette track. After specifying the desired track, the current BAM is displayed for that track. You can free or allocate any sector in that track, and the updated BAM is displayed for verification.

**RENAME DISK (R).** This function allows you to change the 16-character diskette name in the disk directory. The current name is displayed prior to asking for the new value. The disk ID is left untouched.

Recover is a BASIC utility program for recovering scratched diskette files. It makes use of the fact that DOS does not change the file contents or chaining when a file is scratched, but instead, frees the file blocks in the BAM and deletes the file-type and starting track codes in the disk directory. Recover tries to reconstruct this information from the file data and the file directory remnants.

If any of the file blocks have been overwritten by another file, then the file can no longer be recovered. Additionally, the wrong information can be accidentally recovered if you select the wrong starting block or another scratched file has "sliced through" the desired file leaving exactly the same number of blocks following the intersection.

After specifying the desired filename, file type and drive number, the program searches the disk directory for any remnants of your file entry. If none are found, the program aborts. Otherwise, Recover checks all possible starting blocks, that is, all blocks with the sector number indicated in the directory. The program checks that the correct number of blocks is in the chain and that each block is not allocated in the BAM.

This process takes some time, but reduces the number of possible starting blocks to a minimum. Remember that the current version of Recover was written for DOS 1.0. When DOS 2.0 is used, the starting track is not changed in the directory when a file is scratched. Thus, a newer version of Recover for DOS 2.0 might be much faster.

After showing the first few bytes of each of the selected blocks, you have the option to stop, accept and reconstruct the file from this block, take a closer look by viewing more data in the block or continue to the next possible block. If and when a starting block is accepted, the program reenters the file type and starting track in the disk directory and reallocates the file blocks in the disk BAM.

Both Message and Recover are very useful, and possibly very valuable, disk utilities when used correctly. They each perform their respective functions as expected. Sample printouts are included with the printed documentation for Message.

My only criticism concerns the use of

decimal values when displaying various data from the disk. Hexadecimal values may have been much nicer, especially when displaying bit-oriented BAM entries. However, this is really a matter of personal preference and by no means detracts from the overall usefulness of the programs.

As I mentioned in the last column, the various utilities can be purchased separately for \$60 or as a three-program package for \$100. The package price includes Message, Recover and Edit (reviewed last month). The price of each program might be considered high but they could easily repay themselves many times over in the event of a major disaster. After spending several months creating a new program or entering data in a large data base, what would it be worth to recover all that work if it was accidentally erased? □

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# The Six O'Clock Micro News

Brought to You  
By Atari 800  
And the H-89

Two interesting quotes appeared in the news recently. Walter Cronkite, CBS TV's lead newscaster, reportedly said, "It has become impossible to cover the news with the half-hour show. We have a responsibility that we simply cannot discharge." On a tangent subject, Jacques Cousteau is quoted as saying, "The fascinating thing on this planet is that despite all the talk about over-specialization, to a person who's interested, it's much easier to know everything that's going on in the world than it was for Leonardo da Vinci. This is a time of super Leonardos!"

If there is a super Leonardo, and if he or she is looking for more than Mr. Cronkite apparently feels he provides, it is certain data communications will be used to find it. Even if your talents are not up to the level of the Mona Lisa, communicating by computer can cover a wealth of information for you.

Dial-Up Directory is dedicated to the use of microcomputer systems in data communications. In this issue, we will take a look at how two popular microcomputer systems communicate.

## The Atari 800

The Atari 800 is a powerful computer system that has been marketed somewhat differently than most. It suffers a little from confusion with the popular video game systems. Atari has vigorously tackled the education market with a well-planned system of educational programs on cassette tapes. The tapes run with a master educational program cartridge. Although Atari has a good disk drive and disk operating system, they have not pushed disk-based business programs.

But, Atari has recognized the data communications revolution and has given the 800 and its less elegant brother, the 400, a good communications capability. Three things are needed to make the Atari into a bright (certainly not dumb, but not too smart either) terminal: Most importantly, a modem is needed to send and receive audio tones over the phone line. The Atari 830 modem is a popular and proven Novation CAT wearing Atari

colors. The computers do not have an internal RS-232-C port, so the Atari 850 Interface Module is needed to provide the serial data handling capability. The 850 Interface Module contains a microprocessor and an operating program in ROM. It provides one parallel port and four serial ports.

Finally, you need some software. Atari has a program called TELELINK I which provides an adequate data communications capability. The Atari manual mentions a TELELINK II smart terminal program, but that program does not seem to be available yet. TELELINK I comes in a plug-in program cartridge.

Connecting the Atari system together is easy. The cables and sockets are all high-quality, and the instructions are clear. But the RS-232-C ports do not use the standard DB-25 connectors. Instead, they use a unique socket. Atari says these sockets provide a significant cost and size savings over the DB-25. They say an optional adapter cable is in the works. Fortunately, the pins are clearly defined, and anyone with several different pieces of standard RS-232-C equipment can make an adapter cord, but why should he have to?

The only tricky thing about system set-

up is the sequence in which you turn the equipment on. The Atari interface module and disk drive have internal operating programs that have to boot up first so they can answer the computer when it wakes up and asks, "Who's there?" However, the TELELINK I program cannot be used with a disk drive, so the disk must stay off when communicating.

The TELELINK I program becomes operational as soon as the computer is powered up. The program allows the Atari computer to be used as a dumb terminal — when the received or transmitted data scrolls off the screen, it is gone. It also has a unique method of saving received data on a printer connected to the parallel port.

TELELINK I can provide a 1.5K receive buffer in RAM. The program stores received data in this buffer. After 1K of data is stored, the distant end system is given a signal to stop sending (usually a control-S) and the buffer is dumped out to the printer. When the contents of the buffer have been sent to the printer, it is cleared and the distant end is told to start sending again (usually control-Q).

This alternation goes on until all of the desired data is received and printed. In practice, this happens quickly because



The Atari 850 Interface Module provides four serial I/O ports and one parallel I/O port for the Atari 800 and 400 microcomputers. The 830 modem links the system to the telephone lines for data communications.



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8212	2.00	4021	1.19	4082	.35	74C30	.39	74LS27	.39	74LS160	.98	74LS295	1.10
8214	3.95	4022	1.15	4085	1.95	74C32	.99	74LS28	.39	74LS161	1.15	74LS298	1.29
8216	1.85	4023	.38	4086	.79	74C42	1.85	74LS30	.26	74LS162	.98	74LS324	1.75
8224	2.65	4024	.79	4093	.99	74C48	2.39	74LS32	.39	74LS163	.98	74LS347	1.95
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8255A	5.40	4031	3.25	4506	.75	74C95	1.85	74LS54	.35	74LS175	.99	74LS367	.73
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8259A	7.30	4035	.95	4511	1.39	74C157	2.10	74LS75	.68	74LS192	.98	74LS375	.69
8271	60.00	4037	1.95	4512	1.39	74C160	2.39	74LS76	.45	74LS193	.98	74LS377	1.95
8275	32.95	4040	1.29	4514	3.95	74C161	2.30	74LS78	.65	74LS194	1.15	74LS385	1.95
8279	10.80	4041	1.25	4515	3.95	74163	2.39	74LS83	.99	74LS195	.95	74LS386	.65
8279-5	10.80	4042	.95	4516	1.69	74164	2.39	74LS85	1.19	74LS196	.89	74LS390	1.95
8282	6.70	4043	.85	4519	.99	74173	2.59	74LS86	.45	74LS197	.89	74LS393	1.95
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the parallel printer port is fast, but it does take a finite time which can cost the user money on an information utility system.

This buffer/printer cycle can be placed under manual control, and you can simply ignore the printer and let the buffer overflow. This requires some advanced planning if you want to catch some specific data. You have to clear the buffer so you can catch the new data to dump to the printer. No provision is made within the TELELINK I program for the prestorage of messages for later transmission.

The Atari manual lists several BASIC programs that can be used to transfer data files without using TELELINK I. It also includes an interesting program to allow the Atari to run as a terminal using the five-level Murray, or "Baudot," code. This would be useful for communicating on the various specialized bulletin board systems for the deaf that use this code. The manual that comes with the interface is extensive and detailed. It would be valuable to both the novice and experienced user.

The Atari is a superbly constructed system with great potential. Several things are being done to broaden its appeal. First, a good disk-based word processing program is almost ready for release. Second, Atari is ready with some nice disk-based accounting and inven-

tory control programs. The availability of the popular VisiCalc software by Software Arts, Inc., for the Atari has been a big plus, too. But, a more sophisticated terminal package is needed. This seems to be just a gleam in a programmer's eye at Atari, so there is a lot of room for a small software house to bring out a strong cassette and disk terminal program for the 400 and 800.

By the way, Don Stoner's Microconnection for the Atari eliminates the need for the interface module for modem or RS-232-C operations. It plugs directly into the Atari console in series with the cassette or disk drive and gives both a modem and RS-232-C capability. Don supplies a program that addresses the Microconnection and works in a similar manner to TELELINK. I introduced the Microconnection and other products from the Microperipheral Corporation in the October 1980 column.

#### Heath/Zenith H-89

The Heath/Zenith H-89 microcomputer is gaining in popularity. It is a high-quality system available at a good price. Kit builders can gain a great deal of knowledge about hardware and save money by assembling the Heathkit version. I've been using Heath equipment since my first AT-1 amateur radio transmitter (how many remember that one?) and have great praise for their kits. A random sample survey of Heath H-89 owners I conducted shows that all were happy with the system (although several were happier when they started using Digital Equipment Corporation's CP/M operating system). Most builders took a mean average of 50 work hours to put their systems together (there were some wild variations).

The H-89 is really a computer and a terminal in one cabinet. The two pieces of equipment communicate using standard RS-232-C signaling. The terminal is completely separate from the computer and can be used as a dumb terminal all by itself. But, why use a dumb terminal when a program like REACH is available?

REACH is a data communications program written and marketed by Walt Bilofsky of Sherman Oaks, CA. Walt runs the Software Toolworks, specializing in H-89 software. He markets many different programs for the H-89 and offers most of them in CP/M versions. REACH runs under the Heath disk operating system, and at \$19.95 it is a fantastic bargain.

With REACH, the H-89 becomes a truly smart terminal capable of saving received data and transmitting prepared files. An H-89, at least 16K of RAM and an H88-3 serial interface are needed. Operation is as easy as 1, 2, 3. The H-89 provides a row of special function keys which can be defined by software. REACH comes up ready to communicate. If you want everything displayed on the screen to be simultaneously printed by an at-

tached printer, you push the  $f_1$  function key. If you want received data to be saved in a large buffer, simply push  $f_2$ . A special status line on the bottom of the screen shows the option selected and the number of free bytes left in the buffer. This buffer display is a feature many other communications programs could use. A second push on  $f_2$  dumps the buffer to a prenamed disk file. Key  $f_3$  transmits the contents of a file out the RS-232-C port. I don't know of any sophisticated communications program easier to use.

During file transfer, the H-89/REACH system can function in several different modes. The program can simply funnel the data in a steady stream. This would be appropriate for file transfer and for the electronic mail system on The Source information utility. The program can also provide prompted transmission on a line-by-line basis. In this kind of transfer, the host system sends a prompt to the terminal to begin each new line. This prompt is usually the DC1 ASCII character (hex 11), but other characters may be used. REACH can operate in a line-by-line mode with a variety of prompts. CompuServe's EMAIL and several electronic message systems require this prompted mode capability for the transfer of prepared files.

REACH also provides control of auto-answer modems by signaling over certain RS-232-C lines used for special modem functions. An option allows the user to freeze the program and go to the disk operating system without causing the modem to drop the telephone line.

The program comes with a 12-page set of operating instructions. The directions are practical and provide adequate information on operations and various configuration options. The manual assumes the user understands the H-89, its RS-232-C interface, and some ASCII control codes. Inexperienced readers may have to do a little research on some of the terms, but the practical concepts of operation are explained well.

REACH is a bargain. The Software Toolworks has provided a very powerful program at a reasonable price. Their address is 14478 Glorietta Drive, Sherman Oaks, CA 91432.

#### Help Wanted

If you have any data communications comments or questions, send them to me at the address below. I'm particularly looking for news on amateur radio ASCII and CP/M communications. Any readers outside the US with news and views? Include a stamped envelope or IRC if you want a reply. Send electronic mail to TCB967 on The Source; 70003,455 on CompuServe; or the AMRAD CBBS (703-734-1387). □

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# The Language Of Professionals

## What Is The Price Of Enrichment?

*I'm turning this month's "As the Word Turns" over to guest columnist Robert C. Montgomery. Montgomery is a management consultant, professional corporation director and software author. FINPLAN, his financial modeling system for small business, was published by Hayden Books late last year. He lives at 67 Turtle Back Road West, New Canaan, CT 06840.*

"Data are Dead: Long Live Data" (*Microcomputing*, February 1981) is a thoughtful and scholarly comment on the data processing profession's losing battle with the English language. It encourages me to share with others some growing concerns in related areas.

No one can reasonably object to the evolution of the language. It is a continuing, inevitable and desirable process. Were it otherwise, we would still be writing Chaucerian prose, a prospect more alarming than the occasional misuse of a plural noun. But one wants to see improvement of the language, not its debasement by the ignorant. One pays attention when the wonderfully literate editors of the *Wall Street Journal* adopt contractions like "aren't" and "won't." One shudders when a *Microcomputing* author writes "the data is stored."

"Data" is not the only problem. "Criterion" seems to have disappeared, replaced by its plural form. "Criteria" has not yet arisen, but its appearance can only be a matter of time. Infinitives are split like cordwood, and prepositions end sentences as though they were born to the work. "Principal" is confused with "principle," "so" is used as a conjunction, and "nor" has disappeared from English, if not from programming languages. When the industry finally develops computers that can be programmed in English, it will find that programmers don't know how to speak English.

One may argue that a profession has the right to adopt its own usage. Of course. It must certainly be the source of the new words needed to provide for new

technology. But the right to adapt existing words and usage should carry with it a responsibility to understand the existing words and usage, and to evaluate the effects of change. Improvements in precision or in conciseness easily justify change, and so can aesthetic values like the way it sounds. But it's hard to accept change based solely upon carelessness, ignorance or—ugly word—arrogance.

There is reason to believe that arrogance is a part of the problem. The data processing profession has enriched the language with such evocative words as "PEEK" and "POKE," and with "bit," "byte" and "nybble." Enriching a language is a far more difficult task than learning it. Surely, then, it is not an inability to learn with which we are dealing, but simply an unwillingness or an ill-conceived belief that the game is not worth the candle.

At least in part, the profession's disinclination to learn the English language is a symptom of contempt for the culture and values of others. There are precedents in other professions. What hospital looks on its patients as customers, deserving of the courtesies that a businessman routinely accords to his patrons? What lawyer takes the time to thoroughly understand his client's business, or values clarity of expression as highly as professional elegance?

Similarly, how many programmers really understand their employers' businesses? How many know what customers want? How many recognize that the results of their work are far more important than the manner in which it is accomplished? How many managers are buying Apples to develop—through their own efforts—the insights which they cannot obtain from their mainframes and the people who run them? Managers are going back to school to learn computers. How many data processing people are going back to school to learn business?

These are not matters of academic interest only. The plain fact is that the data processing professional who hasn't learned English and won't learn about

business is hurting himself, his employer and his country.

He is hurting himself by limiting his opportunities for advancement to top management. Today's managers will not promote him far unless they feel that he knows the business and can communicate with others. Little mistakes—in English, as well as in facts—are evidence of carelessness in their eyes, and rightly so. Time won't solve the problem. Tomorrow's managers will be a lot more knowledgeable of data processing, but no more tolerant of fundamental weaknesses.

Data processing professionals with these weaknesses are also hurting their employers, because their inability to understand and to communicate limits the ability of the business to use data processing to its fullest extent, and inhibits the spread of logical and analytical processes to other business functions.

And finally, they are hurting their country because data processing technology will be the key to effective management in the coming years of ever-intensified international competition.

\* \* \* \* \*

Also writing in response to the February column, Mike Firth of Dallas, TX, observes the birth of a new mutation—"interger."

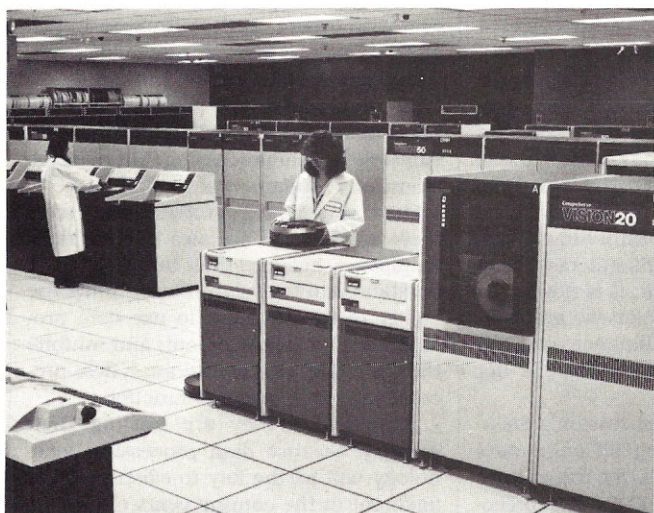
"I have encountered the use of the word 'interger' in at least three different places recently: A label on a shelf edge in a Dallas computer store; in a full-page ad by Micro-Sci in the February *Byte*, page 135; and repeatedly in the instructions distributed by CompuServe for their Missing Link card and their word processor software.

"There simply is no such word as 'interger.' From the context, it is easy to see that the users mean 'integer,' which is spelled without an 'r' and is related to 'integral' and 'integrate.' It means 'one,' 'to make one,' or 'whole' . . . The only possible meaning of 'interger' is 'between gers,'" which is where I think we should leave it." Amen to that. □



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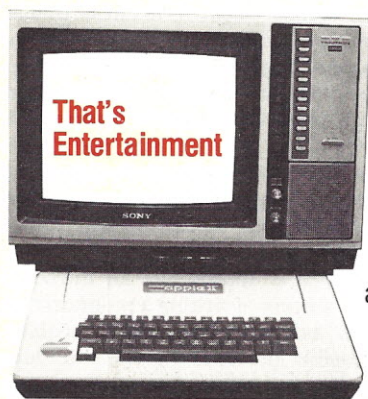


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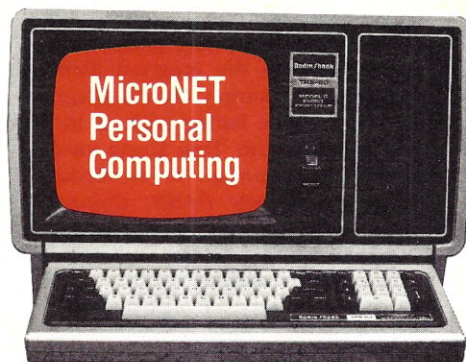
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# Micro Game Strategies

## Good Programming, Not Winning or Losing, Is What Counts

Students usually enjoy writing challenging programs, especially when the result can be enjoyed by others. This column will explore three problems of interest to those seeking this type of material. The problems will also be of special interest to those exploring game strategies or artificial intelligence.

### Tic-tac-toe

The first example is the traditional game of tic-tac-toe. Of course, you can purchase a tic-tac-toe program from any one of several sources, but that's of little interest beyond learning programming techniques from the program listings. You might also simply enter a program from a published listing such as in the John Kemeny and Tom Kurtz classic, *BASIC Programming*, or in *Creative Computing's* book *BASIC Computer Games*. Debugging the result as you attempt to find your typing errors can also be instructive. Writing your own program is more instructive than either of the other two options.

All of the commercially available tic-tac-toe programs share a common characteristic: the programmer has fully analyzed the game. As a result, the program always responds to a user's move with the previously determined "best move." With a game such as tic-tac-toe, this type of play will quickly bore any user, as he has no chance of winning.

I suggest writing this program using an algorithm other than one in which all possible board configurations are known. Just to keep you honest, let's consider a three-dimensional game rather than a two-dimensional one. Write a program that plays tic-tac-toe on a  $4 \times 4 \times 4$  board, on which you win by placing four markers in a row. What type of strategy should the program attempt? Try having the computer follow the same strategy that will be tried by most opponents.

The majority of users are likely to follow a rather simple strategy. For example:

1. Find three of my markers in a row and place a fourth in that row to win, otherwise
2. Find three of my opponent's mark-

ers in a row and place a fourth in that row to block him, otherwise

3. Find two lines of two of my markers in a row so that I can place one marker to have three in a row two different ways, otherwise

4. Find two lines of two of my opponent's markers in a row so that I can place one marker to prevent his trapping me, otherwise

5. Find two of my markers in a row and place a third in that row, otherwise

6. And so forth.

Sounds easy, doesn't it?

Some time ago one of my students wrote a program using a strategy very similar to this one. During the next several months, only one person was able to beat this program.

Those who thrive on game strategy will justifiably be surprised, because an extension of the stated algorithm plays a thorough, uninspired, consistent, but quite beatable game when faced with a forward-thinking opponent. You can, of course, make the program play decidedly better with just a little diagnosis of positional strategy. For example, the eight center positions are of greater value than the eight corners, which are of greater value than the other 48 positions. When placing a marker, considering them in this order will significantly improve the program's playing ability.

Because the final consideration in the strategy list will be making a move at random, the user is likely to see many different sequences of board configurations as he plays several games. A sample program for two-dimensional tic-tac-toe that implements a similar heuristic approach is given in the third edition of *BASIC Programming* by Kemeny and Kurtz. Although Kemeny and Kurtz, the creators of BASIC, wrote this text many years before microcomputers were a reality, the book belongs in the library of every owner or user of a microcomputer.

Writing a program for playing three-dimensional tic-tac-toe that follows a strategy such as this is easier than attempting to anticipate all possible, or even all likely, board configurations.

This type of strategy—trying to emulate the play of a user—can also be used in many other games.

When a program that follows this strategy is available, it nicely demonstrates some of those things that computers do very well. Specifically, the computer rapidly follows an explicit set of instructions and does not forget. Certainly, a computer that follows this strategy isn't thinking; it doesn't even know how to play the game better than most users. But the computer doesn't get excited; it always follows the programmed instructions. Nor does the computer overlook any possibilities; its memory is very good.

### Hexpawn

The second example is a game called Hexpawn. This interesting little game was first introduced by Martin Gardner in the pages of *Scientific American* (Volume 200, Number 3). The game is played on the familiar  $3 \times 3$  board of tic-tac-toe. Each of two players controls three pieces, which are initially placed as in Fig. 1a.

The pieces in Hexpawn have moves similar to those of pawns in chess; that is, one space forward to an empty square or one space diagonally to capture and remove an opponent's piece. Players alternate turns until a winner is determined. One wins this game if any one of his pieces reaches the opponent's side of the board or if his opponent cannot complete his turn because he has no legal move available.

Hexpawn is appropriate for introducing the concept of writing a program that "learns" as it plays. The number of different possible games and game situations is very limited; hence a learning program can become very skilled in a hurry. Within eight to ten games, the computer should become unbeatable.

How does the computer learn? I suggest a remarkably simple strategy that determines all moves for a given board

Walter Koetke, Putnam/North Westchester BOCES, Yorktown Heights, NY 10598.



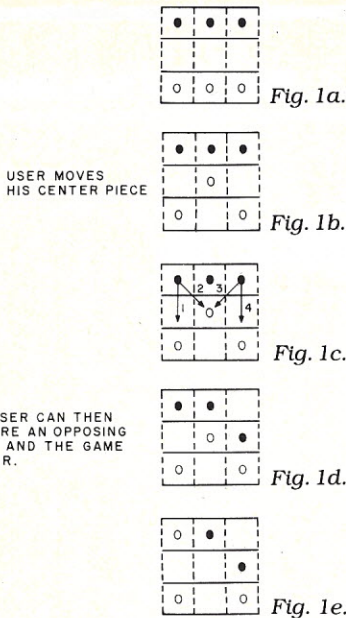


Fig. 1. Game of Hexpawn.

configuration and then eliminates losing moves. In other words, the computer will learn to win only by losing. Nothing is learned by winning. By keeping the strategy so simple, the program does not have to contend with the very clever opponent who purposely loses a few games using a poor strategy in hopes that the computer "learns" some moves as being favorable that really aren't.

Consider the following sequence of play in Figs. 1b-1e, with the computer playing the black pieces. The computer determines that the board configuration in Fig. 1b. has not yet been encountered. Therefore, the configuration is recorded and four possible moves (Fig. 1c) are determined. One of the moves, say number 4, is chosen at random and made (Fig. 1d). The user can then capture an opposing piece and the game is over (Fig. 1e).

After losing the game, the computer should return to the last configuration at which it made a move (Fig. 1c). The program should then record the fact that when this configuration is encountered again, there should only be three possible moves. Because move number 4 led to certain defeat, that option should be eliminated. Thus, when this first game ends, the computer will retain only one board configuration (Fig. 1c) and will have eliminated only one possible move.

Hexpawn makes a nice assembly-language programming exercise. I should underscore, however, that the game's limited parameters make programming in BASIC a very reasonable task.

Finding legitimate, understandable examples of artificial intelligence that can be readily programmed in BASIC on a 16K microcomputer is not an easy task. If any readers are aware of other examples that have some of the characteristics of Hexpawn, please send them for possible inclusion in a future column.

## Neutron

The third programming example is based on a game introduced by Robert A. Kraus in *Games and Puzzles* (no. 71) and further discussed by Charles Wetherell in *Dr. Dobbs's Journal* (no. 35). The game is called Neutron, and I suspect you'll find it considerably more challenging than either of the others already discussed. Neutron is a two-person game played on a 5x5 board. The board with the pieces in their starting position is shown in Fig. 2a.

All moves except the first are composed of two distinct parts. The player must first move the neutron, and then one of his own pieces. Moves are made horizontally, vertically and diagonally. When a move is made, the piece must move as far as possible—until it is adjacent to another piece or against the edge of the board. Pieces are never captured; all 11 are always on the board.

Neutron is won when the neutron piece is moved into your back row by you or your opponent. The game is also won if your opponent cannot complete both parts of his move.

The first player does not move the neutron on his first move. This rule is intended to offset the advantage of having the first move. Figs. 2b-2d are intended to clarify the rules. Clearly the white player's strategy was less than exemplary.

This game can be approached at several different levels:

1. Write a program that makes legal moves selected at random.
2. Develop a strategy that determines the relative value of each move and then proceed accordingly. This illustrates a key aspect of many chess-playing programs in a far less complicated game.
3. Write a program that learns as it plays, as you already did with Hexpawn. Neutron is notably more complex than Hexpawn, and a different sort of learning strategy may be appropriate.

Neutron is definitely a non-trivial game. If you write a program that plays well, please send it to me so it can be shared with other readers.

The programs suggested in this article offer a multi-edged challenge to the programmer. A successful effort requires far more than quickly writing some BASIC code. First, the game must be fully understood. Second, an algorithm for playing must be determined. Third, you must find a method for representing that algorithm on the computer. Fourth, screen formats should be considered so the game is appealing to the user. Finally, the usual steps of program entry, testing and debugging must be completed.

The suggested programs, when finished, will be enjoyed by users and be a feather in their creator's cap. They can also be used as part of a computer literacy program, as each demonstrates a different aspect of strategies used in the study of artificial intelligence. □

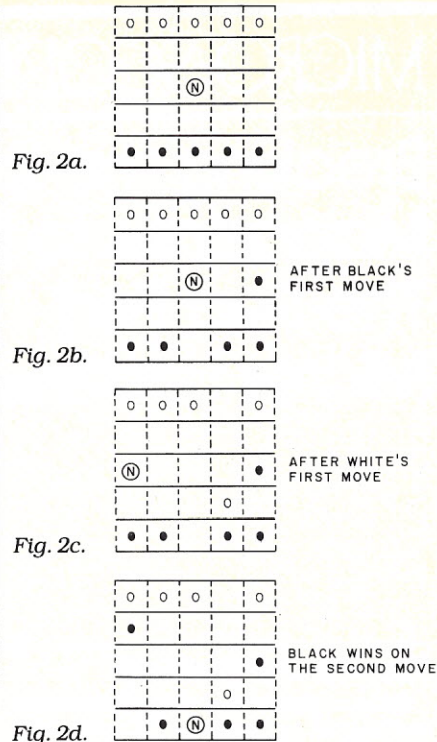


Fig. 2. Game of Neutron.

## All About OHIO SCIENTIFIC BASIC in ROM Second Edition

The first edition went through 4 printings. Now revised and 50% new text added. All commands, statements, and functions are thoroughly described. Subtle points are illustrated by short programs. Over half the book is "Exotic and Elegant BASIC" and memory maps. Topics include USR(X), Bugs and Fixes (including 2 for the Garbage Collector), Speed, Space and Clarity, Utilities: Line Renumber, BASIC Trace (new), Program Compactor and many more. Tapes: BASIC, Autoload, and Homemade. Tape Writer Program for OSI Format machine language tapes, Hooks into BASIC's innards, Keyboard and Screen Tricks. Much about the machine language side of BASIC: The Stack, Code and Tokens, Floating Point Numbers and Variable Tables, Maps: \$00,01,02. Addresses: \$A000-BFFF. Commented disassembly of the MONITOR in \$FE,FF.

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# Breaking the Ice with a Micro Magazines to Moonlight, Fantasize By The Red Peril Micros Underwater

## Dynamic Daisywheels

Sales of daisywheel teleprinters could increase by as much as 15 percent by 1985, says a recent report from Venture Development Corp. The study says that the demand for fully-formed character teleprinters will grow with the word processing market.

The study reports that while three U. S. companies control 50 percent of the market for letter-quality printers, certain Japanese manufacturers pose a strong threat. It also says that the future of the daisywheel printer depends on how much of an impact high-resolution dot matrix and ink-jet printers have.

At present, says the report, dot matrix printers can't match the daisywheel for speed, while ink-jet printers are too unreliable. Both are still in the research and development stage.

For more information on the report, which is titled *The Teleprinter Industry: A Strategic Analysis*, contact Wendy Abramowitz, Market Research Analyst, Venture Development Corp., 1 Washington St., Wellesley, MA 02181 (617-237-5080).

## The Ultimate Icebreaker

Having trouble getting people at your parties or conventions to interface with one another? Do your computer buddies become catatonic when they're dragged out of their hovels and forced to face humanoid life forms?

Arizona Digital Corp. thinks it has the right product for you—the Alter Ego.

ADC has packed the punch of a values clarification workshop into a microcomputer the size of a cigarette lighter. Any two people with Alter Egos can immediately tell whether they're compatible, no conversation or other human interaction necessary. Dr. Joyce Brothers calls it

"the ultimate icebreaker."

Before the function, each person enters the answers to 96 questions into his Alter Ego. The people then walk around and touch Alter Egos, receiving a digital reading that supposedly indicates levels of agreement and compatibility. They can then shake hands or throw punches, depending on how compatible they are.

The questions come in two booklets—*Personality Factors* and *Management Style*. The former includes queries on such topics as sexual drive, relationships, independence, and one's sense of responsibility. The latter asks about such matters as interaction with other employees, work-related character traits, communication, career goals and company management.

ADC says that the devices let people meet without exposing their inner feelings. They also make conversation pieces, whether the digital reading indicates compatibility or incompatibility.

The Alter Ego costs \$29.95, with the per-item price decreasing according to quantity. For more information, write Arizona Digital Corp., 4246 E. Wood St., #330, Phoenix, AZ 85040.

## Mag for Moonlighters

There are lots of ways to make money with a microcomputer. One of them is to tell people how to make money with a microcomputer. That's what J. Norman Goode is doing, with his newsletter *Micro Moonlighter*.

The monthly periodical, says Goode, is for the person "who has a system at home and wants to recoup his investment or use his micro for a cottage industry."

The newsletter will include "quick hints that the reader can use to improve his business," Goode says. He plans to run several regular columns, including

one on advertising and one on computers and the law. Goode plans for the moment to avoid feature-length articles, concentrating instead on short tidbits of usable information.

Goode is convinced that there is a market for his newsletter. "Everyone's coming out with one or more books on how to make money with a micro," he says. "Obviously, if the book publishers are releasing these titles, someone must be buying them."

For the moment, Goode is comfortable with the newsletter format. Although *MM* might eventually metamorphose into a magazine, Goode doesn't want it to become too slick.

"I would like to eventually solicit articles and be able to pay for them," he says.

*Micro Moonlighter* is scheduled to premier in May, and will run eight pages. Charter subscriptions are \$25 a year in the U. S., \$29 in Canada and \$35 worldwide.

For more information, contact Goode at 2115 Bernard Ave., Nashville, TN 37212.

## CBM Puts Together Disaster Program

Commodore Business Machines has put together a disaster/emergency plan computer program to be distributed nationally to some 500 dealers. The program, which was a direct result of the MGM Grand Hotel fire in Las Vegas last November, is designed to help local relief organizations in the event of a disaster.

CBM mobilized seven business systems after the MGM fire, to help keep track of the whereabouts of the thousands of people in the hotel at the time. The computers were also used to help people make air and ground transportation arrangements.

The program was designed by Brian



Padol of Micro Research, and is based on a Commodore information list management system program.

"We just came to the realization that most large municipalities are not equipped to handle such an emergency," says Margaret Jillett, director of public relations at Commodore.

## Magnetic Fantasies

If your appetite for computer fantasy games and related material is insatiable, you might want to try a new bimonthly magazine called *Magnetic Fantasies*.

It costs \$2.95, which is a lot of money to pay for only 28 pages. Furthermore, *MF* is sloppily put together, and the writing is generally atrocious. But the editors partly redeem themselves with good spirits and a freewheeling sense of humor. From the Tablet of Contents to the liberal use of parenthetical witticisms from the editors, *MF* has a hard time taking itself or its topic very seriously.

The first issue came out in February, and is highlighted by an article titled "On the Lack of Morality in Adventuring." Author Clyde Primm, an obscure L. A. actor, bemoans the fact that Adventure responds to such commands as fight, attack and kill but not to love, caress, calm and soothe.

"Morality must be brought back into this game," he says. "Programmers must allow for statements like, 'Soothe dwarf,' 'Coo to bird,' 'Ask mummy what he has been doing for the last five centuries.' This would stop the corrupting influence this game has on our youth."

The first issue also includes a bibliography of fantasy game programs appearing in the major microcomputing magazines, a bibliography of articles about fantasy games, a list of the games currently on the market and several software reviews.

Editor Richard Koch says that *MF* had an initial press run of 500 copies, 100 of which have been distributed through an announcement on several computer bulletin board services. The response, he says, has been good, and he hopes that the magazine can grow into a full-blown enterprise.

But if *Magnetic Fantasies* is serious about its future, it will have to improve its writing and editing. A sense of humor is not enough to carry a magazine to the Magic Kingdom of Success.

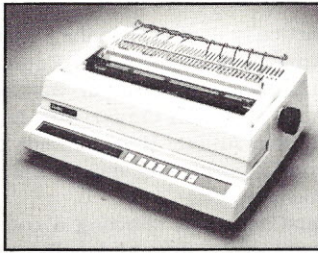
For more information, write the editor at 100 S. Edgemont, Apt. 1, Los Angeles, CA 90004.

## The Red Peril

Is Kilobaud Microcomputing inadvertently aiding and abetting a Communist conspiracy to steal high-tech secrets from the U. S.? Apparently so, according to right-wing columnist Phyllis Schlafly.

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ingenious and daring in its operation designed to steal American computer technology," she says. "For starters, the Soviets simply bought U. S. technical magazines from bookstores and borrowed them from libraries."

In addition, she says, the Soviets have been buying up millions of dollars' worth of microcomputer equipment and illicitly shipping it back to the Old Country.

The Institute of Strategic Trade, she further claims, has gathered "a hair-raising collection of tales of espionage, large cash payments and businessmen making tremendous profits on illegal deals while paying insignificant fines."

In view of this frightful situation, we suggest that you memorize this magazine and then eat it.

### No Clock for Apple III

The Apple III microcomputer will no longer include its special built-in clock/calendar circuit. The price of the Apple III has thus been reduced by \$50.

The company says that it has not been able to find a satisfactory supplier.

The battery-integrated circuit is used to log time and date information automatically on files the computer has stored. Users can enter this information manually on the keyboard.

Customers with Apple IIIs will receive

a \$50 rebate. Anyone who sent in their warranty card should get a letter and rebate offer.

### Diving into Computers

*Microcomputing's assistant managing editor Sue Gross was out in Las Vegas recently, and brought back this report:*

Practically next door to the Consumer Electronics Show, the Diving Equipment Manufacturers Association was at the Hilton Convention Center with its own exhibition. Among the hundreds of exhibitors, I found three companies using microcomputers.

AquaComp was showing a complete microcomputer system for dive shops. Sherwood was displaying their regulator evaluation program for the Apple II. And Jeppesen/Sanderson was showing how they are developing a program for diving instruction that includes a microcomputer, video tapes and video disks.

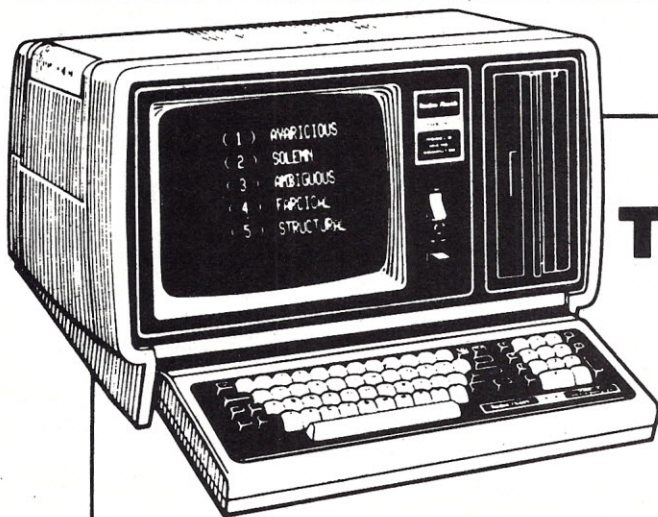
AquaComp's system, which is also called AquaComp, uses OSI's C2 4P, with disk drives, CRT and printer. The system covers every aspect of the diving business, and includes such programs as Instruction, Travel, Student File (see Fig. 1), Repair and Parts Inventory and Rentals and Rental Inventory. It also includes such general programs as Payables and Receivables, Inventory, Purchasing and

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STATE	12345
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OCCUPATION	UNIV. OF MINN.
EMPLOYER	M
SEX (M or F)	8/4/36
DATE OF BIRTH (mo/day/yr)	68
HEIGHT (inches)	155
WEIGHT (pounds)	BROWN
HAIR COLOR	BLUE
EYE COLOR	2/16/81
IF PHYSICAL TAKEN (mo/day/yr)	CHARLES O. TUCEK
PHYSICAL GIVEN BY DR.	GOOD
PHYSICAL CONDITION (comments)	3/19/81
DATE CLASS BEGINS (mo/day/yr)	BASIC
CLASS LEVEL	PARADISE HEALTH CLUB
CLASS LOCATION	BOB ROBERTS
NAME OF INSTRUCTOR	150.00
TOTAL COURSE PRICE (\$)	DEP. \$50--BAL. 1ST CLASS
PAYMENT ARRANGEMENTS	\$50.00
TOTAL PAID TO DATE (\$)	1/25/81
LAST PAYMENT MADE (mo/day/yr)	3/19/81
NEXT PAYMENT DUE (mo/day/yr)	AVERAGE
PERFORMANCE ON POOL TEST	10
NUMBER OF CLASS SESSIONS	8
NUMBER OF SESSIONS ATTENDED	100
FINAL WRITTEN EXAM SCORE	100
FINAL POOL TEST SCORE	EXCELLENT
CLASS WORK (comments)	ADEQUATE IN SWIM TEST
POOL SKILLS (comments)	3
NUMBER OF CHECK-OUT DIVES	1ST DIVE--TROUBLE W/MASK
CHECK-OUT SKILLS (comments)	Y
CERTIFICATION ISSUED (Y or N)	6/17/81
CERTIFICATION DATE (mo/day/yr)	PADI-BASIC
CERTIFICATION AGENCY AND LEVEL	BOB ROBERTS
CERTIFYING INSTRUCTOR	249
TOTAL EQUIPMENT PURCHASES (\$)	1/16/81
LAST EQUIP. PURCHASE (mo/day/yr)	0
TOTAL TRAVEL PURCHASES (\$)	0
LAST TRAVEL PURCHASE (mo/day/yr)	0
RATED CLASS--1=EXCLNT/5=POOR	3

Fig. 1. Typical AquaComp student file.

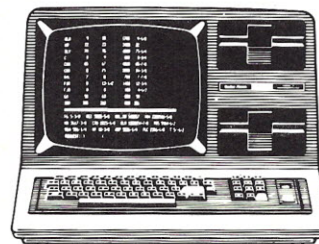
General Ledger. As an option, AquaComp can be made into an electronic cash register with a cash drawer. The price is \$7000.

AquaComp has a password security system, as well as a built-in patented ROM chip specific to each machine. Thus, the software cannot be run on any



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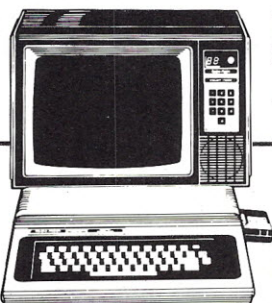
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```
mt:
  proc options(main);
  dcl
    m fixed binary,
    y fixed binary,
    P fixed decimal(11,2),
    PMT fixed decimal(6,2),
    i fixed decimal(4,2);
  do while(1'b);
    put skip list('Principal ');
    get list(P);
    put list('Interest ');
    get list(i);
    put list('Payment ');
    get list(PMT);
    m = 0;
    y = 0;
    do while (P > 0);
      if mod(m,12) = 0 then
        put skip list('Year',y);
        m = m + 1;
        put skip list(m,P);
        P = P + round( i * P / 1200, 2);
        put list(PMT);
        P = P - PMT;
      end;
    end;
  end;
end pmtr;
```

E = 01BA  
SA = 000C  
MS = 3C86  
MPILATION





Photo 1. Sherwood's Apple II in use with the hyperbaric chamber.

other microcomputer. The programs can be copied for backup purposes with a copying program supplied with the system.

When I was at AquaComp's exhibit, they already had 50 committals. Not bad for a few days' work.

AquaComp is a division of American Research Service Corp., 175 Fifth Ave., No. 1101, New York, NY 10010.

At the large Sherwood Selpac booth, I found an Apple II being put to an industrial use. Sherwood (120 Church St., Lockport, NY 14094) makes valves and regulators for scuba diving. They are using their Apple II with a hyperbaric chamber, a breathing machine and a pressure transducer to test their regulators for efficiency.

In essence, the Apple II receives signals through an A/D converter from the pressure transducer, which is placed inside the regulator being tested. The regulator is hooked to the breathing machine inside the hyperbaric chamber, which simulates the water pressures experienced when scuba diving.

The program, written by Robert J.

Miller of Freeville, NY, first dimensions the pressure data arrays. It then clears the screen and displays the menu of options (a. calibrate the pressure transducer; b. run a test; c. end session). After the pressure transducer is adjusted, tests can be run, and the operator then enters pertinent data about the test.

The breathing machine has a switch to trigger the data gathering phase at the start of the breathing cycle. The Apple II loops through the data arrays and stores the raw pressure data (up to 400 entries). This data is examined and run through formulas to calculate kilogram-meters per liter, and another array is filled with the modified data. A grid is plotted with x-y coordinate values and the test criteria are printed at the bottom of the screen (see Photo 1). The smaller the size of the pressure volume loop, the less work the diver's lungs must do and the more efficient the regulator.

This program and the Apple II let Sherwood make fast, accurate tests of their own, and their competitors', regulators.

Their Apple II, by the way, is just a 16K model, and uses only a cassette.

The Jeppesen/Sanderson booth was demonstrating the use of video tape for diving instruction. Upon further discussion with R. D. Swanson, director of marketing for special programs, I learned that Jeppesen/Sanderson has been developing interactive teaching systems incorporating a computer and a video disk.

The diving program is still in its early stages, but J/S has been selling a similar program to flight schools to help with judgmental training. They are also working on a program to train bank tellers how to spot fraudulent checks, hot checks, counterfeit money, and so on.

The beauty of this type of system is the video disk's random access feature. It's ideal for use with a computer in interactive training, because the computer can go back and cover points that the student has missed or needs more help on.

As a final note, the DEMA show wasn't the only place computers were in evidence. Not having been in Vegas for many years, I was surprised (I suppose I should have expected it) to see the profigate abundance of computerized one-armed bandits (Bally slot machines). Pull the arm, and the beautiful color graphics spin just like the real thing. There are various computer card games too. Naturally, I lost.

## MICRO QUIZ

### What Does This Program Do?

```
10 A = 1 : B = 1 : S = 0
20 FOR I = 1 TO N
30   S = S + A
40   C = A + B
50   A = B
60   B = C
70 NEXT I
80 END
```

In N = 9, what is the value of S after the program is executed?

(answer on page 192)

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Intended use of ZX80 \_\_\_\_\_

Have you ever used a computer? ☐ Yes ☐ No Do you own another personal computer? ☐ Yes ☐ No

0-4-KM







## Revealing Secret Code

I particularly enjoyed Alan Sclawy's excellent article in your November issue, "CP/M Encryption Prescription" (p. 42).

As the author pointed out, one defect in his program is that plaintext characters must be inserted if the encryption process results in certain control codes. A solution is to map the control codes onto the ASCII codes from 128 to 159.

At the end of the encryption cycle, test the resulting code to see if it is less than 32; if so, complement it with "NOT"; reset the sign bit to zero with "XOR - 128"; and add 32. The process is simply reversed at the beginning of the encryption loop.

In CBASIC, we have the following at the start of the loop:

```
IF P%>127 THEN P%=NOT(P%-32) XOR (-128)
```

At the end of the loop is:

```
IF P%<32 THEN P%=((NOT P%) XOR (-128))+32
```

I think you are performing a public service by helping to disseminate knowledge of cryptographic techniques, and I hope you publish more articles on this subject.

**John A. Thomas**  
Dallas, TX

See p. 64—Editors.

## Megabytes on Cassette

A product has been on the market now for about a year that does just what you asked for in your November 1980 "Publisher's Remarks" (New Ideas, p. 8)—that is, allow the storage of ten megabytes of Winchester data on a regular cassette.

The Corvus Mirror is a low-cost backup for the Corvus Winchester disk system employing standard video recording technology. It converts the output of the Corvus 10 or 20 megabyte Winchester disk into a stream of serial bytes which can be recorded on any videotape recorder. The most common video machine used for this purpose is the video cassette recorder because it offers the convenience and low cost of easily available cassettes.

Data is backed up at a one megabyte per minute rate, permitting the entire contents of a Corvus Winchester disk to be copied in ten or 20 minutes. Total capacity of a cassette is 120 megabytes. Thus, the Mirror serves not only as a security backup, but also provides archival storage. In a larger sense, it allows micro-

computer users to enjoy both the sealed environment reliability of the Winchester disk system and the convenience of cassette loading at the same time by re-loading cassette data back onto the disk as needed.

**Joseph D. Hughes**  
Vice-president, Marketing  
Corvus Systems, Inc.  
San Jose, CA

## All Shapes and Sizes

Arnold Bragg's article "Area Estimation" (October 1980, p. 112) showed an amazingly effective algorithm for its simplicity. Its greatest weakness is that only straight lines (not curves) are fitted between the data points.

To test the formula for its ability to fit curves, I used a circle with the radius of 1 and chose the data points so they were equally spaced around the circumference. For comparison, I also calculated the area of an N-sided inscribed polygon. The area determined by the formula is always the area of the inscribed polygon.

Fitting a curved line is more of an inconvenience rather than a fault of the algorithm. Any inconvenience the fitting creates is more than made up for by the algorithm's ability to fit very complex shapes. The only time the algorithm failed was for the ring figure, and I tried to do the outside and the inside area in one pass. This could easily be handled by making two passes—one for the outside and the second one for the inside—and then subtracting the differences.

**Bob Fruit**  
Hinsdale, IL

## A Change in the Standings

Here's some new information that changes some of the data in your recent article "The 16-Bit Time Trials" (*Kilobaud Microcomputing*, October 1980, p. 182).

The Z8000 CPUs are now available from both Zilog and Advanced Micro Devices in 6 MHz clock rate versions (called the 8001A and 8002A). Use of the A version reduces cycle times to two-thirds that of the 4 MHz parts, resulting in execution times and rankings in your Table 2 of 32 us (#1) for table lookup, 712 us (#3) for block move, 5.3 us (#1 tie) for jump table and 13.3 us (#3) for multiply.

The execution time index changes to 0.596 (#2), and the overall index changes to 0.799, which makes the Z8000 number one in rank.

**John Springer**  
Advanced Micro Devices, Inc.  
Sunnyvale, CA

## In Praise of Kit Building

We enjoyed very much your January feature on "Assemble a Super Business System" by Dr. Tom Lukers. It certainly highlighted the money savings and expanded design capabilities one can achieve from building his own computer system in kit form.

Congratulations to you and Dr. Lukers on a fine article.

**Myron Kukla**  
Advertising and Public  
Relations Coordinator  
Heath Company  
Benton Harbor, MI

## The Importance of Being Zero

Regarding Messrs. Price and Piescik's disagreement about zero numbering (Letters to the Editor, p. 27, October 1980), zero numbering is definitely *not* "an established design practice that novices might as well go along with." Zero numbering will seem rather pointless until one enters that "mysterious" world of assembly language. Then, zero numbering becomes a necessity and not some mere tradition.

First is the ease of indexing. In Mr. Price's example of the tracks on a floppy disk starting at track 0, suppose our program inputs any track number and looks in a table called DDATA which contains one byte per track to tell us what is on that track. Now remember that the label DDATA is actually the address of the beginning of the table, which is the first entry. The track number is merely added to the address DDATA to obtain the correct byte. That is, to reference the first track (track 0), zero is added to DDATA, and since DDATA points to the first entry, the correct offset is chosen. If the first track was track #1 instead of #0, then either one would have to be subtracted from the track number before indexing, or the first entry in DDATA would have to be filled

(continued on page 211)



# FCC Takes Aim Against RFI Polluters

By Chris Brown and Eric Maloney

**D**eep within the confines of the CPU, hidden away in an orderly world of LSI clusters, crisp square waves obediently cycle and time, control and consort. Strict schedules keep them moving in lockstep as data is fetched, registers are incremented, stack pointers set and numbers crunched. Speed is of the essence: the user is an impatient master hoping to save a microsecond here, a nanosecond there. Frequencies run to the megahertz, and the benefits of brevity in instruction implementation are paramount.

But feeding on the square waves' speed and strength is the bugaboo of the computer revolution—radio frequency interference. Disruptive and counterproductive, RFI takes the form of thousands of harmonically related multiples of the square wave's fundamental frequency.

This RFI renders nearby communications receivers unusable. Just sit in a room with a working microcomputer, and listen to a radio. It doesn't matter what frequency you tune to—easy listening FM, Top 40 AM, air traffic control, amateur or emergency. As the machine cycles through its instruction set, there is intermittent noise from 1 to 1000 MHz, an annoying staccato buzz coming from the processor through the keyboard, along the spaghetti maze of wiring, over the recorder leads, out of the ribbon cables and even through the ac power line. The hash pervades the surrounding environment.

It was only a matter of time before RFI caught the attention of the Federal Communications Commission, the government agency responsible for refereeing the use of the radio spectrum. After three years of



study, the FCC handed the microcomputer industry a mandate: Get rid of the RFI by January 1981, or close up shop.

The FCC wasn't kidding—the new rules are tough. Microcomputers marketed for home use (called class B computing devices) may not generate appreciable RFI from 450 kHz (just below AM radio) to 1000 MHz (above UHF-TV). The same regulations apply to peripheral devices, whether sold separately or as part of a system.

Microcomputer manufacturers must also follow a complex, time-consuming and expensive certification procedure. A note from Mom simply won't do—the manufacturer has to test its product, submit the test information to the FCC, complete ap-

plication forms, submit photographs and pay certification fees.

The price for noncompliance is harsh. The equipment cannot be marketed or advertised in the U.S., whether manufactured domestically or imported.

By last fall, it became obvious to many companies that they could not meet the January deadline. Firms like Apple, Commodore, Exatron, Lobo and Heath went to the FCC praying for mercy and stalling for time. They all won extensions to April 1, but the reprieve did little to relieve the pres-

*Chris Brown is the assistant technical editor of 80 Microcomputing, and Eric Maloney is on the Kilobaud Microcomputing staff.*



sure. In fact, as of press time, a few observers speculated that some firms might have to halt production, or perhaps even go out of business, if further extensions were not forthcoming.

For most manufacturers, the cost will be high. The final bill for personnel, equipment, testing and modifications could run into the hundreds of thousands of dollars.

And what will be the impact on the consumer? Most obviously, he will have pay the costs through higher prices. He also might find it difficult to interface certain systems and peripherals. And, in the long run, he might find fewer new products on the market.

### Inevitable

Considering the history of RFI regulation, the new rules concerning micros come as no surprise. From the early days of diathermy to present-day data processing, the FCC has moved slowly but effectively to limit the interference potential of many types of devices. In 1947, an adolescent FCC allocated certain frequencies for use by industrial, commercial and medical equipment with the provision that these devices meet technical standards that specified limitations on radiation. More recently, the FCC moved to control RFI-generating CB sets.

"Because the spectrum is a valuable but limited resource that can be used in various but incompatible ways, simple economic efficiency suggests that such a resource be employed in its most valuable way," says a Microcomputer Industry Trade Association (MITA) report. "By issuing its new rules the FCC has decided that radiation from electron-

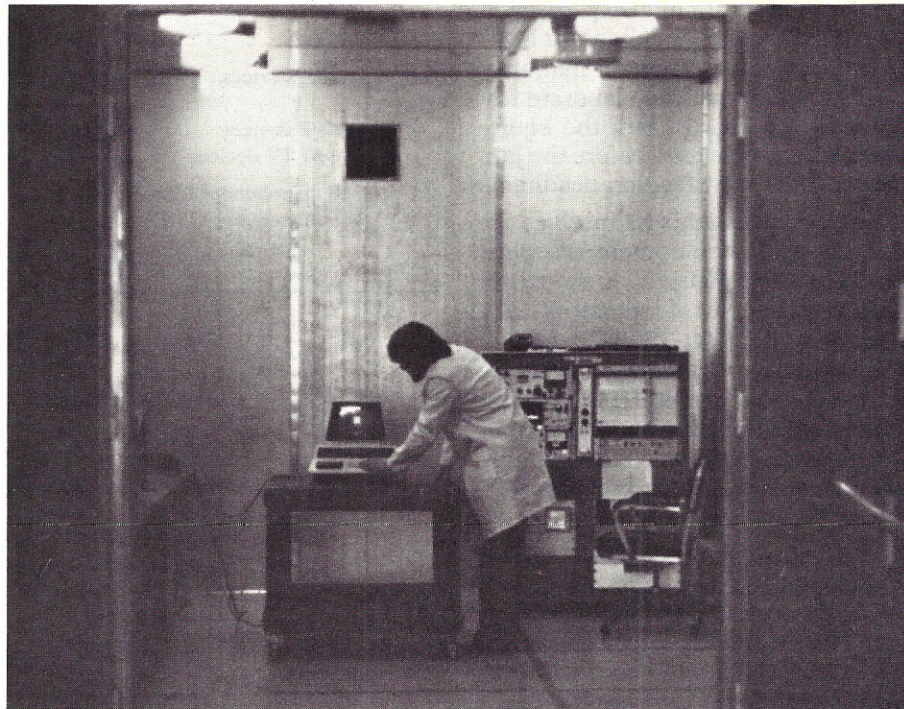


Photo 1. Interior of the RF-proof, shielded chamber of R and B Enterprises' test facility. A PET micro is being tested. Photos and figures courtesy of R and B Enterprises.

ic devices is a less valuable use of the spectrum than the radio services with which they might interfere."

The new rules distinguish between two kinds of micros: those marketed for use in commercial settings (class A) and those intended for use in residential settings (class B). In each case, the marketing strategy of the manufacturer determines the class of the device. Class B computing devices include the Heath H8 and H-89; the TRS-80 III, and Color Computer; the Apple II; the Commodore PET; and OSI C1P and C4P; and the Atari 400 and 800.

The class B technical standards are much tougher than those of class A

(see Figs. 2a and 2b). The FCC's reasoning was that home computers are in closer proximity to interference-prone equipment like TVs, short wave radio receivers and land mobile equipment. They also felt that class A devices are more carefully maintained and responsibly operated.

The two classes of computers face entirely different procedures to gain FCC approval. Class A devices need only verification. This is essentially an honor system in which the manufacturer tests his equipment to ensure that it meets FCC requirements, but doesn't need to notify the FCC. Certification, on the other hand, is an equipment authorization issued by the FCC for equipment designed to operate without individual license. The equipment receives a certification number which must appear on the computing device.

Manufacturers of class B devices have faced problems in two major areas: testing and modification. Both take time and money.

For example, while electromechanical compatibility (EMC) testing technology has been known and used for many years, an air of mystery still surrounds test procedures. Lately, only a few specialty labs have been doing EMC testing on the government's behalf.

Last June, in response to pressure

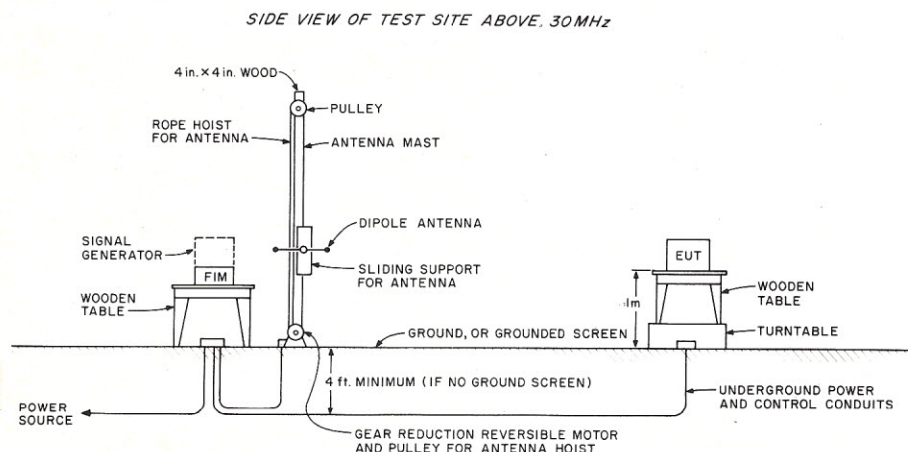


Fig. 1. Typical test fixture used in radiated emissions testing. Site size can be three, ten or 30 meters.



from the computer industry, the FCC published federal guidelines for EMC testing. It left little time for manufacturers to construct the elaborate test fixtures (see Fig. 1), buy the equipment and run the tests before the January 1, 1981, certification deadline.

The measurements themselves are simple. But the equipment is sophisticated and expensive. A spectrum analyzer capable of operating to 1 GHz costs \$10,000-\$30,000. Add to that the cost of building a test site complete with remote control turntable, calibrated dipole antennas and full ground screen, and smaller manufacturers find the project impossible.

Some manufacturers have turned to independent test labs, such as R and B Enterprises of Plymouth Meeting, PA. R and B specializes in all types of EMC testing and will perform the required tests (see Photo 1). Their fees vary, but a ballpark figure for class B testing is \$1000 a session. Most micros can be tested in one or two sessions.

### Industry Ordered To Clean Up Its Lines

Class B computing devices must meet two RFI requirements (see Figs. 2a and 2b). Power-line-conducted measurements determine the RF component from 450 kHz to 30 MHz present on the computer's ac power cord. Radiated VHF emissions determine the RF field radiated by the computer between 30 MHz and 1000 MHz. In both cases, a spectrum of frequencies is scanned within which any detected RF energy must be below specified values. Unfortunately, several variables which have a direct effect on the measurements must be accounted for if the results are to be accurate.

In power-line-conducted measurements, the impedance of the ac network the computer is connected to affects test results. Since the load placed on this network by other equipment is unpredictable, a line impedance stabilization network (LISN) must be connected in series with each supply conductor of the unit under test to provide standard test conditions. The LISN must be bypassed and filtered on the supply side so that adverse ef-

fects of supply impedance are minimized.

Some confusion exists as to what type of network should be used, since differing values of inductance affect RFI levels and frequencies. An LISN using a 50  $\mu$ H series inductance with the line is now accepted as standard by the FCC (see Fig. 3).

Radiated VHF emissions can be measured in several ways but require the use of a qualified test site. To find out if his test site is qualified, a manufacturer must run tests to determine the site's attenuation. This is done by comparing signal attenuation levels with two identical, calibrated half-wave dipole antennas according to a specific, FCC approved procedure. Site size can be three, ten or 30 meters and both indoor and outdoor test sites are allowed, as long as they are constructed in a fashion the FCC finds appropriate (see Fig. 4).

Thirty-meter sites generally display the best attenuation characteristics but are the most costly to build. When tests are run indoors, a shielded room is suggested. (See Photo 1.)

### Frequency (MHz) Maximum RF Line Voltage ( $\mu$ V)

Class A devices:	0.45-1.6	1000*
	1.6-30	3000*
Class B devices:	0.45-30	250*
Class 1 TV devices:	0.45-25	100#
* 50 microhenry LISN		
# 5 microhenry LISN		

Fig. 2a. RF voltage limits for power-line-conducted emissions.

Device	Frequency (MHz)	Distance (meters)	Field Strength ( $\mu$ V/m)
Class A:	30-88	30	30
	88-216	30	50
	216-1000	30	70
Class B:	30-88	3	100
	88-216	3	150
	216-1000	3	200
Class 1 TV:	30-47.7		15
	47.7-1000		15

Fig. 2b. RF voltage limits for radiated emissions.

printer and so on, the tests must determine which configuration of hardware generates the most RFI. Also, micros that accept peripherals must be checked with each combination of equipment available. As far as the FCC is concerned, an 8K CPU that has the potential of being upgraded to 16K is actually two different computers. The 8K version may meet radiation requirements while the 16K doesn't. It is the manufacturer's re-

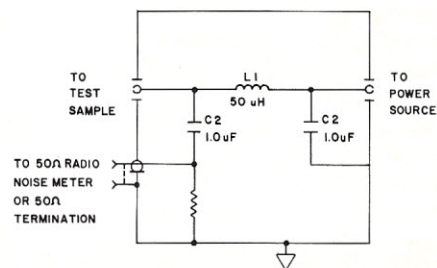


Fig. 3. LISN circuit used in power-line-conducted tests.

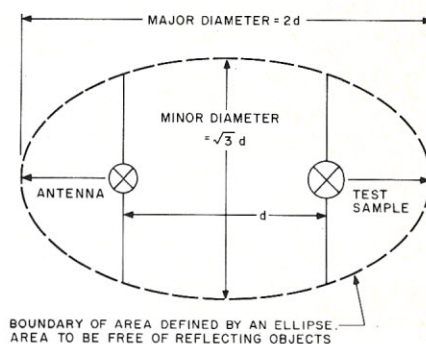


Fig. 4. Geometry of open field test site. Area within ellipse must be free of reflecting objects.

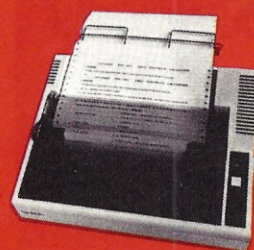
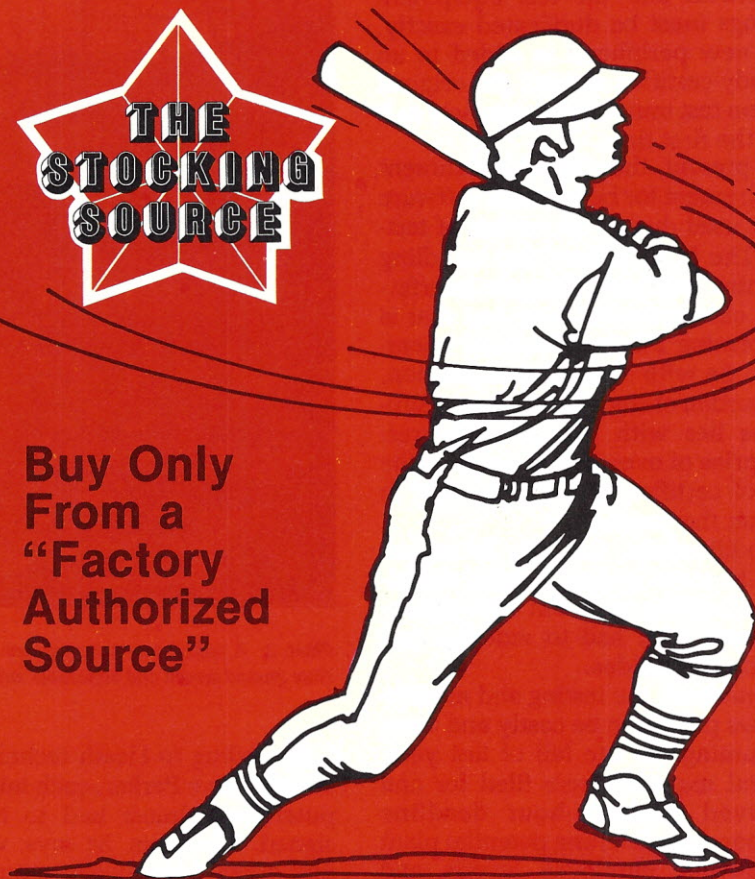
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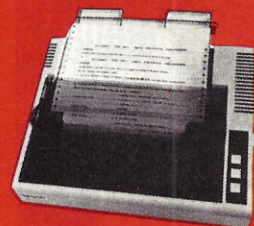
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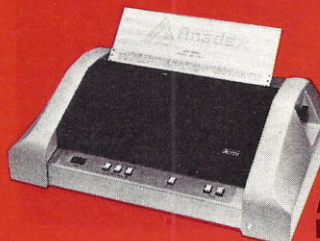
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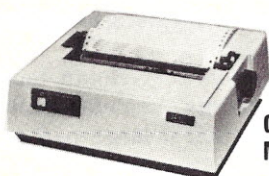


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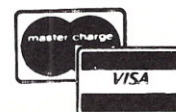
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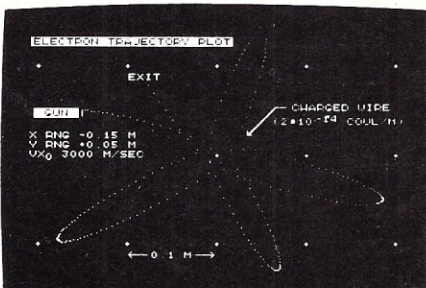
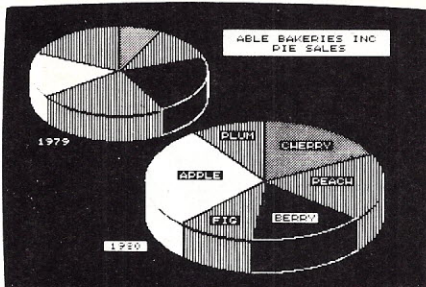
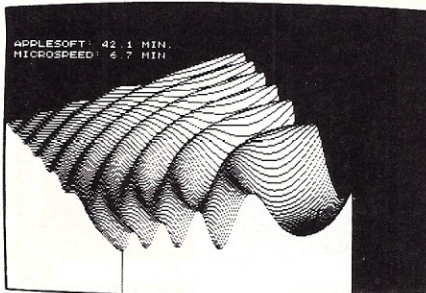
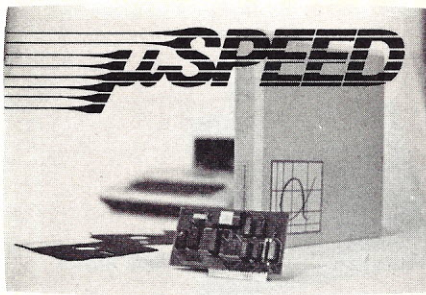
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sponsibility to cover all bases.

The manufacturer must keep complete test records. If a test has to be repeated on demand, the hardware placement and the test equipment settings must be duplicated exactly. If a new peripheral is added to an already-certified system, the original system test must be run precisely as it was the first time.

At present, there is no government requirement for benchmark software to be used during the course of testing. The FCC realizes that an idling machine will have different interference characteristics than one that is performing I/O or arithmetic operations. As with system configuration, the burden of finding worst-case situations lies with the manufacturer. The price of oversight or deceit is the loss of certification and the right to market the product.

Modifications, too, can be expensive. In some instances, extra shielding will do the trick. But other manufacturers have had to redesign and modify the insides.

Combined, the testing and modifying has proven to be costly and time-consuming. In late fall of last year, several manufacturers filed for and received eleventh-hour deadline postponements, citing potential plant shutdowns, employee layoffs and severe economic hardship.

### Unhappy Manufacturers

The FCC originally set the deadline for July 1, 1980. But the chore was simply too overwhelming. Many firms didn't have the equipment or the personnel, and weren't even too sure of what exactly the FCC wanted. As one engineer puts it, "Just interpreting the documents was a major effort." So responding to pressure from the industry, the FCC moved the class B deadline up to Jan. 1, 1981.

Even with the extra six months, many manufacturers found that they could not do all of the testing and make the necessary modifications in time. By late fall, the FCC found itself with a number of requests for postponement.

Ironically, one of the first was the Heath Company. The veteran of electronics manufacturing filed its letter on Oct. 20, stating that the task of meeting the new regulations was "monumental." The company claimed that it had spent nearly \$375,000 on one product family alone.

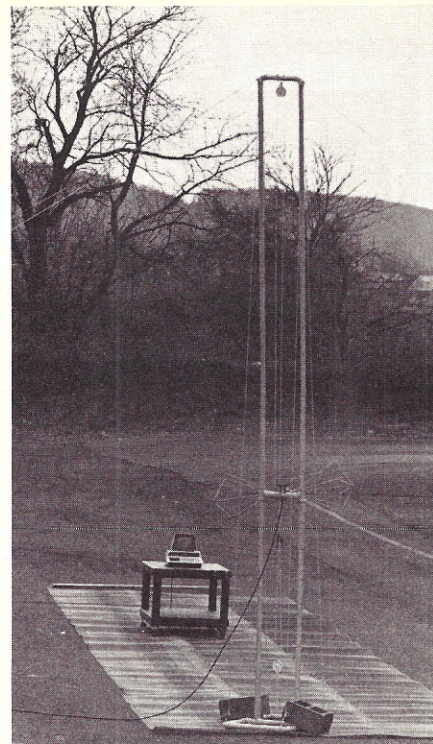


Photo 2. A typical ten-meter outdoor test range. Note ground screen and adjustable antenna mast.

According to Heath technical consultant Steve Parker, each microcomputer has almost had to be redesigned. The units, he says, will look and operate identically, "but the insides will be entirely different."

"It's basically like developing a completely new product," he says. "Only we're not going to get anything out of it."

Parker says that Heath faces special problems because hobbyists make up such a large part of their market.

"Some companies can simply put a metal box around their computers," he says. "But ours have to be user-serviceable. Our customers need to get in there, especially if they're building a kit."

He cited other problems: "Apple, for example, doesn't have any video circuits. Our video circuits are creating more noise than anything else."

Parker won't say for certain that all of Heath's computers will be certified by April 1.

"Our engineers are working hard on it, and our legal department is working on getting extensions," he says. "We're optimistic that one way or another we'll be able to stay in production."

Apple, too, has had its share of expenses. One executive at Apple told



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an industry newspaper in February that the company has spent \$100,000 on testing equipment, added four people to the engineering staff and made "quite a sizeable change" in the Apple II.

People in the industry mention other problems. For instance, very little information on RFI test procedures is available. An *exo facto* ruling prohibits current FCC employees from discussing such matters with members of the industry, and the literature on RFI is scant. A two-day seminar in Boston sponsored by R and B drew over 100 computer hardware engineers, representing firms like Centronics, DEC, Itek and NEC. The company is running similar seminars in several other cities to dispense information on requirements and testing and on modification.

Also, companies are unable to make major purchasing commitments until their modified devices are approved. Thus, even though a firm might meet the April 1 deadline, it might be faced with a lag time between approval and production. This could severely disrupt production and marketing schedules.

Not everyone has experienced the problems Heath and Apple have. Radio Shack's line of TRS-80s received their certification by January, as did the Atari computers and Texas Instruments' TI 99/4. In fact, some technical people in the microcomputer industry feel that the obstacles have been vastly exaggerated.

"We designed our Color Computer from the start to be pretty much noise-free," says Steve Leininger, director of advanced development at Tandy/Radio Shack. "We, along with everyone else, knew that we were living on borrowed time."

Leininger adds that the expense of tests and modifications depends largely on the abilities of the technicians involved.

"To a digital computer designer, the solutions are not that obvious," he says. "To someone experienced in RFI, it's not that big of a deal."

B.J. Freeman, an engineer at Exidy Systems, agrees. An engineer with the proper background, he says, could do the job in six months; someone without the experience could take one and a half to three years.

"If the manufacturer gets someone with experience in magnetics, they shouldn't have any trouble modifying," Freeman says.

Leininger says that other computers, like the Atari, were originally designed to meet the requirements for a class 1 TV device. These standards are even stricter than those of class B.

### Passing the Bucks

To the consumer, the impact of the new standards will be most noticeable when retail prices go up. Apple is adding \$135 to its Apple II price. Heath's Steve Parker says Apple's figure "is in the ballpark."

In the long run, the consumer might be faced with a decrease in the number of new products being made. Some manufacturers will not find it profitable to continually release new models in the numbers and variety computer buffs are used to. Smaller manufacturers may simply not be

able to allocate sufficient money and manpower to ensure that their equipment meets radiation requirements. This could eventually reduce the amount of research and development going on, since much of this activity is in the province of the small company.

In addition, some variety and flexibility of hardware may be lost as the number of products decreases and the possibility of equipment combinations becomes limited. For example, are Lobo drives approved for use with the Apple III or only the Apple II? Is an Exatron stringy floppy OK to use with a Radio Shack Model IV or Model V, or both?

Owners of two identical systems may not be able to swap parts, if they happen to be built before and after

## Trying to Live in Harmony With Harmonics

By Frank J. Derfler, Jr.

**T**here go the federal bureaucrats again. Getting into everybody's business and making the price of everything go up. Why did they come up with this Part 15 anyway?"

Contrary to what you might think, the FCC has used Part 15 for a long time to protect the frequencies of each radio service and to prevent the pollution of the radio spectrum. If you take a look at that old CB walkie-talkie in the bottom drawer, you will find it probably complied with Part 15. Garage door openers, radios and TV all fall under Part 15 of the Federal Communications Commission's rules governing low power communications and restricted radiation devices. Only in late 1979, after digital devices had been interfering with the radio services for several years, did they bring computing devices under their control.

The FCC issued their first report

and order on computing devices in October 1979. In April 1980, as the result of many petitions, they extended their deadlines for compliance with emission restrictions until January 1981. They have divided microcomputers into two classes: those marketed for commercial and industrial use (class A) and those marketed for residential use (class B). The requirements are more strict for type B machines, because they are in closer proximity to television and radio receivers.

This is the same FCC that recently deregulated the telecommunications industry to foster business and competition. This is the same organization that cannot economically afford to police the citizen band radio spectrum for minor violators. The FCC is not a power-hungry empire-building bureaucracy. But the cross-hatch on the TV set can only be ignored for so long—the buzz on the police radio cannot be ignored at all.

The attention of the FCC was drawn to computer devices by complaints from police and fire departments,

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the new regulations. Thus, a businessman may own two identical Heath H-89s, but not be able to interchange boards.

We finally come to the issue of enforcement. Can the FCC put teeth into its certification stipulations in the real world?

The FCC has the authority to pursue cease-and-desist orders, or, in extreme cases, felony convictions. The latter could involve fines and prison terms of up to two years. Users, too, are liable, and can be ordered to shield their equipment. While it is unlikely that a cadre of RFI police will be raiding the homes of interference-generating computerists using unauthorized mixes of hardware, it is possible that manufacturers will be forced to design equipment in such a

way that unapproved interconnects become difficult.

As fast as old problems are faced, new ones arise. As MITA points out, "changing work patterns will slowly blur the environmental distinctions between the home and office, and evolving communication services will continue to place additional demands on spectrum usage." What will the FCC do when more radio receivers are used in commercial environments? Or when more class A computers are used in residential areas?

Predictions can only be tentative. Recent commission actions come at a time when decontrol is a Washington watchword. How Republican President Ronald Reagan's new FCC chairman will view commission in-

The schedule of two-day seminars being conducted by R and B Enterprises to inform companies about the FCC-imposed computer specifications is as follows:

Baltimore—April 27/28

Boston—April 23/24

Chicago—April 27/28 and May 4/5

Denver—April 30/May 1 and May 6/7

Hartford—April 23/24

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volvement in this elemental level of microcomputing remains to be seen.

But for the moment, no one in the industry is too pleased with the first chapter of the script. ■

amateur radio operators and TV viewers. Coin-operated video machines were among the first to draw fire. Public watering holes that had spent considerable sums on high antennas and wide-screen TV projection systems found themselves with wide-screen wavy lines whenever someone slipped a coin in a video game.

I own a 1977-era microcomputer system. (A depreciated antique to everyone but the IRS.) When I'm on the system, my family cannot watch most of the TV channels because of radiated interference. This is not a new story. There are several very widely used commercial terminals which were radio frequency polluters long before microcomputers became available. Anyone who has ever tried to use a police scanner or amateur radio receiver near one of these systems knows how widespread the interference can be.

The RF radiation from microcomputers is particularly nasty because it is so varied, has so many harmonics and has such good antennas. Oscillators can be found on memory boards, CPUs, I/O ports and all through computer systems. They operate on many fundamental frequencies spread between 1 and 20 MHz. Little or no design effort was made to restrict the harmonics of their oscillation because computers run fast and fast speed means wide bandwidth. Strong signals in the spectrum above 300 MHz can be detected hundreds of feet away from many microcomputer systems. A typical microcomputer has a maze of wires and cables lead-

ing to peripheral devices. These leads make excellent antennas for RF radiation.

The leaky RF design of digital circuits can work both ways. It can let interference in as well as out. I have personally witnessed an electronic Christmas toy (a programmable tank) running under an operating table cause the complete crash of a TRS-80 Model I during a disk read. What goes out can come in.

Some portions of the industry were slow to respond to subtle warnings about the danger of inviting regulation by marketing devices producing so much interference. But other manufacturers, most notably Radio Shack and Atari, were able to produce new clean systems at reasonable prices. The Radio Shack TRS-80 Model III and Color Computer and the Atari 400 and 800 computers passed the certification tests run by the FCC. The Hewlett-Packard HP-85 and Texas Instruments 99/4 are also certified.

Both Heath and Apple have been granted waivers for their systems through April 1981. The folks at Heath say privately that they had to go for outside engineering help experienced in RFI design to clean up their line. Most of the changes were not in exterior packaging, but in design details. They probably found that little things such as cable routing, circuit board arrangement and ground plane shielding mean a lot. Word is that H-89 deliveries are being slowed by the changes.

The rumors persist that the Apple III has been delayed because of RFI

problems. It was due for testing at the FCC laboratories in Maryland in February. Those of you with Apple II computers should know that a parts kit is available from Apple Computer to reduce the interference radiated from this system. The kit (part number 652-0152) has some capacitors for bypassing, ferrite beads for choking and solder lugs for grounding.

Bypassing, choking and grounding unwanted signals have been standard design practices of electrical engineers from the days of vacuum tubes. Several graduates of prestigious electrical engineering schools told me that today's students who elect to go into digital systems in their junior year are never exposed to those "RF techniques" at a practical level.

Shielding has also always been important in containing RF. Metal cabinets combining adequate shielding and cooling are expensive items. (Rumors also say Commodore is now benefiting from early problems with plastic cabinets which gave them a great metal cabinet line.) Some manufacturers are using a metallic compound called aqua-dag (usually found in TV picture tubes) to line the inside of their cabinets to reduce radiation.

In the end, the computing public will benefit from the FCC Part 15 enforcement. We will have equipment with new designs that will be both less interfering and less subject to interference from outside RF sources. Additionally, cleaner systems may bring peace to many residential computer users who now have to negotiate for air time. ■



# Save It with CASSY

By Andrew N. Messent

I had used my OSI C1P for a few months before I became aware of two major deficiencies in its ROM software.

First, it lacks a routine to save a machine-language program: the C1P ROM monitor can load a machine-language program but not save it. OSI markets an extended monitor that can save machine-language programs in a checksum format, but a saved program can only be loaded by the checksum loader in the extended monitor. The extended monitor also occupies over 2K of RAM, effectively leaving 1K for user programs (in a 4K system). Furthermore, there is no way to make a stand-alone back-up copy of the extended monitor.

Second, the BASIC SAVE command occasionally creates a tape that will not load correctly. Since the C1P has no cassette verification routine, the only way to check a tape is to load it; if the tape is bad the C1P gives a syntax error on any lines that wrap around to the next CRT line.

After spending many hours inputting and debugging a particularly long and complex program, I dumped out the data from a bad tape and discovered the C1P was inserting extra line-terminating characters at the point that the line wrapped around to the next CRT line. The line would load fine up to the extraneous characters, but the C1P then treated the second half as a new line and gave a syntax error because there was no line number.

I wanted to design a small ma-

chine-language program that could save any area of memory to the cassette recorder. It had to be small enough to be useful in a 4K system and easily input using the C1P ROM monitor. The tapes saved had to be auto-loading by the C1P ROM monitor's L command. There could be no software requirements other than the C1P ROM monitor. The program had to create tapes that transferred control back to the C1P ROM monitor after loading.

As designed, CASSY occupies 230 bytes of RAM at hex 0F00 to 0FE5 and uses seven page zero locations, hex 00B9 through 00BF. The program can easily be modified to transfer control to any memory location (even to the program that it is loading).

## Implementation

The OSI C1P is a versatile machine with some nice surprises for an inquisitive programmer. The cassette interface is controlled by an MC6850 UART that is under software control.

The UART has two memory locations associated with it. The status and control registers are located at F000, and the read and write registers are at F001. A byte written to F000 goes into the control register; a byte read from F000 comes from the status register. A byte written to F001 goes into the transmit data register; a byte read from F001 comes from the receive data register. The UART status and receive data registers can't be written to, and, conversely, the control and transmit data registers can't

be read.

To make use of the UART a certain sequence of steps must be followed.

1. Master-reset the UART.

2. Initialize the UART for the correct baud rate, number of data bits, number of stop bits, parity and interrupt logic.

3. Read the UART status and check the appropriate bit for the empty receive or transmit data register.

4. Read or write a byte of data.

5. Loop until all data has been transferred.

6. Flush the last two data bytes out of the UART.

Once you fully understand the UART operation and you also realize that the OSI ROM monitor's L command just transfers control to the cassette port, it is a simple matter to create a tape that controls the computer. That is essentially what an auto-load tape does.

The auto-load tapes are divided into three main parts: header, body and trailer. The header consists of the monitor commands to load the tape to the memory locations from which the recording was made. The body is the main part of the data, recorded a byte at a time followed by a carriage return. The trailer consists of the commands to return control to the ROM monitor.

## Program Description

The program is broken down into a

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*Address correspondence to Andrew N. Messent, 1306 Pinewood Drive, Frederick, MD 21701.*

---



main routine and three subroutines.

The subroutine that actually writes a byte to the cassette is called PUT. PUT reads the status register at F000 and loops until bit 2 is high, indicating that the transmit data register is empty. PUT then writes a byte to the transmit data register at F001 and returns to the calling routine.

PUT2 converts a byte of data into two ASCII characters and writes each, by calling PUT, to the cassette.

GETAD prompts for the starting and ending memory addresses to SAVE. GETAD uses two OSI ROM routines, FEED and LEGAL, at hex FEED and FE93, respectively. FEED accepts characters from the keyboard, and LEGAL checks to see if a valid hex character was entered. GETAD calls FEED and LEGAL and gets a pair of valid hex characters at a time. It converts each pair into a single hex byte, which is returned to the main routine.

CASSY calls GETAD, which prompts for the starting and ending addresses. The starting address is written to the cassette by PUT2 and PUT as an auto-load header, and is saved as the pointer to the current memory location. The memory contents to save are converted a byte at a time into two ASCII characters followed by a carriage return, which are then written to the cassette port.

The current memory location is then incremented and compared to the ending memory location. If they are not equal, the program loops back and processes the next byte. When all memory locations have been written, CASSY writes the commands onto the tape that returns control to the ROM monitor. CASSY then jumps to FE0C (the OSI ROM monitor's entry point).

### Input CASSY Using the C1P's ROM Monitor

The easiest way to get CASSY up and running is to input it the way I did, a byte at a time, using the C1P ROM monitor. Power-up your C1P and hit the break key, followed by the M key. Then type in .0F00/. This procedure puts the monitor into the address mode, loads address 0F00 and then transfers the monitor to the data mode. Referring to the hex dump, each pair of characters is a byte. Starting at the upper-left corner of the dump and working to the right and down, type in a byte at a time, followed by a carriage return.

Go to the beginning and check the

Program listing. Assembly-language cassette save program for the OSI C1P.

```

=====
* * * C A S S Y * * *
=====
WRITTEN 10-FEB-80 BY ANDREW N. MESSENT
=====
A CASSETTE SAVE PROGRAM THAT CAN SAVE THE CONTENTS OF ANY
MEMORY LOCATIONS TO THE CASSETTE PORT. THE TAPE CREATED WILL BE
AUTO-LOADING AND WILL TRANSFER CONTROL TO THE ROM MONITOR UPON
COMPLETION.

*=$0F00                                ;ASSEMBLE AT HEX 0F00
FEED  =FEED                             ;C1P KEYBOARD INPUT ROUTINE
LEGAL =FE93                             ;C1P HEX VALIDATE ROUTINE
CASSY LDY  #00

;
; CURRENT CRT POINTER IS CONTAINED IN HEX 00BF AND 00BE
;
LDA  #$45
STA  $BE
LDA  #$D3
STA  $BF

;
; GET THE START ADDRESS, STORE IN HEX 00BD AND 00BC
;
JSR  GETAD
STA  $BD
JSR  GETAD
STA  $BC
LDA  #$2C
STA  ($BE),Y
INY

;
; GET THE ENDING ADDRESS, STORE IN HEX 00BB AND 00BA
;
JSR  GETAD
STA  $BB
JSR  GETAD
STA  $BA

;
; RESET THE UART
;
LDA  #$03
STA  $F000

;
; INITIALIZE UART FOR CASSETTE OPERATION
;
LDA  #$11
STA  $F000

;
; WRITE THE AUTO-LOAD HEADER TO THE CASSETTE
;
LDA  #$2E                                ;AN ASCII "."
JSR  PUT
LDA  $BD                                ;HI ORDER START ADDRESS BYTE
JSR  PUT2
LDA  $BC                                ;LO ORDER START ADDRESS BYTE
JSR  PUT2
LDA  #$2F                                ;AN ASCII "/"
JSR  PUT

;
; GET A BYTE OF MEMORY AT A TIME AND WRITE IT TO THE
; CASSETTE AS 2 ASCII CHARACTERS FOLLOWED BY A CARRIAGE RETURN
;
LDY  #00
LDA  ($BC),Y
1$ JSR  PUT2                                ;WRITE A BYTE
;
LDA  #$0D                                ;WRITE A <CR>
JSR  PUT
;
; INCREMENT THE POINTER
;
INC  $BC
BNE  2$
INC  $BD
2$ LDA  $BD
;
; SEE IF DONE
;
CMP  $BB
BNE  1$
LDA  $BC
CMP  $BA
BNE  1$
;
; WRITE THE COMMANDS TO THE CASSETTE THAT WILL RETURN CONTROL
; TO THE ROM MONITOR.
; THE CODE HERE CAN BE MODIFIED TO TRANSFER CONTROL TO ANY
; DESIRED ROUTINE, INCLUDING THE PROGRAM LOADING.
;
LDA  #$2E                                ;AN ASCII "."
JSR  PUT
LDA  #$46                                ;AN ASCII "F"
JSR  PUT
LDA  #$45                                ;AN ASCII "E"
JSR  PUT
LDA  #$30                                ;AN ASCII "0"
JSR  PUT

```

More



Program listing continued.

```

LDA    $$43                ;AN ASCII 'C'
JSR    PUT
LDA    $$47                ;AN ASCII 'G'
JSR    PUT

;
;      FLUSH THE LAST CHARACTERS OUT OF THE UART
;
LDA    #00
JSR    PUT
JSR    PUT

;
;      RESET THE UART
;
LDA    $$03
STA    $F000

;
;      RETURN TO THE C1P ROM MONITOR
;
JMP     $FEOC

=====
;
;      ***  END OF MAIN  ***
;
=====
;
;      ***  SUBROUTINES  ***
;
=====
;
;      ***  GETAD  ***
;
GETAD  JSR    FEED            ;GET A CHARACTER
        STA    ($BE),Y        ;DISPLAY
        JSR    LEGAL          ;VALID ?
        CMP    $$80
        BEQ    GETAD          ;NO !
        INY
        ASL
        ASL    A              ;THE LO ORDER NIBBLE IS THE
        ASL    A              ;HIGH ORDER NIBBLE OF THE
        ASL    A              ;ADDRESS BYTE
        STA    $B9            ;TEMP STORAGE
3$     JSR    FEED            ;GET A CHARACTER
        STA    ($BE),Y        ;DISPLAY
        JSR    LEGAL          ;VALID ?
        CMP    $$80
        BEQ    3$            ;NO !
        INY
        AND    $$0F           ;MASK OFF UPPER NIBBLE
        CLC
        CLD
        ADC    $B9            ;ADD TO HI ORDER NIBBLE
        RTS

;
;      ***  PUT  ***
;
PUT     TAX
4$     LDA    $F000            ;GET THE STATUS
        AND    $$02           ;BIT 2 ONLY
        BEQ    4$            ;NOT READY
        STX    $F001          ;SEND A BYTE
        TXA
        RTS

;
;      ***  PUT2  ***
;
PUT2    PHA
        AND    $$F0           ;HI ORDER NIBBLE
        LSR
        LSR    A
        LSR    A
        LSR    A
        CMP    $$0A           ;SEE IF ALPHA
        BMI    5$            ;IF 0 - 9
        CLC
        CLD
5$     ADC    $$07            ;IF A - F
        ADC    $$30           ;TO ASCII
        JSR    PUT
        PLA
        AND    $$0F           ;LO ORDER NIBBLE
        CMP    $$0A           ;IF ALPHA
        BMI    6$            ;IF 0 - 9
        CLC
        CLD
6$     ADC    $$07            ;IF A - F
        ADC    $$30           ;TO ASCII
        JSR    PUT
        RTS

;
;      ***  END OF SUBROUTINES  ***
;
=====

```

More

contents of all memory locations. CASSY should be ready to run a preliminary test. Type in .0F00G and 0300. The program will give a right arrow. Type in 0310. In about ten seconds the screen should clear and memory location 0000 will be displayed in the upper-left corner of the CRT. If that ran correctly, the ROM monitor will be back in control. If CASSY did not operate as described, go back and verify all memory locations. Make sure that you didn't transpose any digits, type in a B for an 8 or make a similar error.

CASSY should be ready to put to work. The first program to save is CASSY. Set up the cassette recorder to record, with a blank tape advanced past the leader. Type in .0F00G followed by 0F00. Start the recorder and type in 0FFF. In about one minute when the screen clears and memory location 0000 is displayed, shut off the recorder. You have just made an auto-load copy of CASSY.

You must try to load the tape to check it. Set up the cassette recorder to playback, hit the break key and type in M. Start the cassette recorder playing back and type in L as soon as the tape has advanced past the leader. The memory locations and contents will be sequentially displayed in the upper-left corner of the CRT. The program is loaded when control has been returned to the ROM monitor.

CASSY can be used to SAVE any memory locations to the cassette port. If you are going to use CASSY with BASIC programs, you must also record the contents of memory locations 007B through 0080, which point past the end of the program to the available working storage that BASIC uses. When you load the BASIC program, you must restore those values to their original locations; otherwise, when you run the program, BASIC will start over-writing it with the program variables. You will have to limit the memory size if you will be running BASIC at the same time CASSY is in memory.

## Summary

The listing and hex dump presented here locate CASSY at 0F00 to 0FFF. I am currently maintaining two copies of CASSY, one located at 0300 and the other at 0F00. CASSY can be relocated by changing the addresses after each JSR command. Make sure you don't change the addresses of FEED and LEGAL, since they are OSI's



Program listing continued.

```

=====
***  HEX DUMP OF CASSY  ***
=====
HEX DUMP OF CASSY LOCATED AT 0F00
=====
START      :      MEMORY CONTENTS
=====
0F00 : A0 00 A9 45 85 BE A9 D3 85 BF 20 BD 0F 85 BD 20
0F10 : 8D 0F 85 BC A9 3E 91 BE C8 20 8D 0F 85 BD 20
0F20 : 0F 85 BA A9 03 8D 00 F0 A9 11 8D 00 F0 A9 2E 20
0F30 : B4 0F A5 BD 20 C1 0F A5 BC 20 C1 0F A9 2F 20 B4
0F40 : 0F A0 00 B1 BC 20 C1 0F A9 0D 20 B4 0F E6 BC D0
0F50 : 02 E6 BD A5 BD C5 BB D0 EA A5 BC C5 BA D0 E4 A9
0F60 : 2E 20 B4 0F A9 46 20 B4 0F A9 45 20 B4 0F A9 30
0F70 : 20 B4 0F A9 43 20 B4 0F A9 47 20 B4 0F A9 00 20
0F80 : B4 0F 20 B4 0F A9 03 8D 00 F0 4C 0C FE 20 ED FE
0F90 : 91 BE 20 93 FE C9 80 F0 F4 C8 0A 0A 0A 85 B9
0FA0 : 20 ED FE 91 BE 20 93 FE C9 80 F0 F4 C8 29 0F 18
0FB0 : D8 65 B9 60 AA AD 00 F0 29 02 F0 F9 8E 01 F0 8A
0FC0 : 60 48 29 F0 4A 4A 4A 4A C9 0A 30 04 18 D8 69 07
0FD0 : 69 30 20 B4 0F 68 29 0F C9 0A 30 04 18 D8 69 07
0FE0 : 69 30 20 B4 0F 60 00 00 00 00 00 00 00 00 00
0FF0 : 00 00 00 00 00 00 00 00 00 00 00 00 00 00
=====

```

ROM routines.

An enterprising individual could supply any number of enhancements to CASSY. How about named files? CASSY could be modified to prompt for a file name and write some sort of header to the cassette before the actual file. You would have to create a LOAD program to load the correct

file, but it would not be difficult. To load a file, the program would search the tape for the correct file header before transferring control to the ROM monitor. The ROM monitor would then just load as normal. Now if someone could come up with a cassette deck control port that could operate the cassette deck motor. . . . ■

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# Quicksilver Micro System

By Peter W. Marcus

A microcomputer lends itself well to monitoring the environment. With this in mind I decided to use my microcomputer evaluation kit to record and display the present temperature and the low and high extremes since last reset.

## Design Considerations

Such a system requires a temperature transducer and some form of analog-to-digital converter to interface to the computer. Initially, I experimented with thermistor temperature transducers, but these have a nonlinear temperature-versus-voltage response and thus are difficult to use over wide temperature ranges. Therefore, I decided to use the LM334 (Photo 1).

This is a three-terminal integrated circuit, the output voltage of which varies linearly with temperatures from 32 to 158 degrees Fahrenheit. It is connected as a current source;

thus, its output is independent of supply voltage variations, and the resistance of long connecting wires does not affect transducer output.

A voltage-to-frequency converter, along with software, does the analog-to-digital conversion. An advantage of this method is that it requires only one bit of input port. Also, the analog-to-digital converter board (Photo 2) can be conveniently located away from the computer, since only two wires are needed to carry the serial data.

## System Operation

The system operates as follows (see Fig. 1): The LM334 (IC1) outputs a current proportional to the temperature. This current is converted into a voltage proportional to the temperature, across the load resistor (R1). This voltage is buffered by op amp IC2a and offset as required for calibration by op amp IC2b.

The voltage, proportional to the temperature, is fed into the input (pin 7) of the LM331 voltage to the frequency converter (IC3). The LM331 puts out narrow negative trigger pulses at a frequency proportional to temperature. These pulses are too narrow for detection by the computer, so a D-type flip-flop (IC4) is connected in a divide-by-two mode at the output of the voltage-to-frequency converter. A 50 percent duty cycle wave, which gives adequate pulse widths, is obtained.

Using both the offset adjustment (R2) and slope adjustment (R3), a square wave whose frequency equals degrees Fahrenheit times ten is obtained at the output of the D-type flip-flop (IC4). This square wave is fed into an input port of the computer for processing.

Note that the zero offset voltage is derived from pin 2 of the LM331 (IC3), which supplies a highly stable 1.9 V reference. This makes the zero offset independent of the temperature and power supply variations.

Other factors making the circuit accurate and temperature independent include low temperature coefficient resistors (1 percent resistors) and capacitor (polypropylene capacitor C1), 15 turn cermet potentiometers (R2

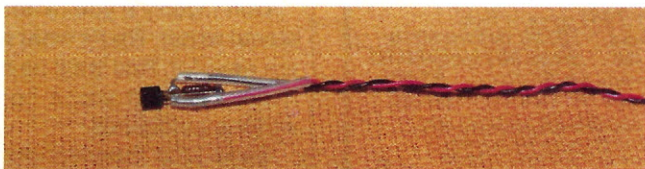


Photo 1. The LM334 temperature transducer, with resistor and twisted pair leads soldered to it for remote operation.

(Photos by Jean Fazio)

Peter W. Marcus, 10225 Coral Way, Apartment B-122, Miami, FL 33165.



and R3) for precise adjustability, and the use of the highly linear and temperature-stable LM331 voltage-to-frequency converter.

I got the design information on the linear integrated circuits from the 1978 *National Semiconductor Linear Databook*.

## Software

It was necessary for the computer to count frequency divided by ten rather than direct frequency. The initial output from the temperature-to-frequency conversion circuit can be a zero or one, which causes a  $\pm 1$  count fluctuation when frequency is measured directly. Therefore, the circuit was designed to output a square wave at a frequency equal to ten times the ambient temperature.

For example, at 70 degrees F the frequency is 700 Hz. Thus, the computer simply measures the frequency divided by ten, with the result equal to degrees Fahrenheit. The computer then compares the temperature with the previous minimum and maximum value and stores any new minimum or maximum. The computer used was the Motorola MEK6800D2 kit (Photo 3).

The program is set up so that the computer spends one second measuring temperature (frequency/10) and three seconds in which the low, current and high temperatures are output sequentially. To measure frequency divided by 10, the program polls the input port for a change in level. After 20 changes in input level (10 cycles), a count is stored. This process is continued for one second, making the result the frequency in cycles-per-second divided by 10. The one second window is set by going

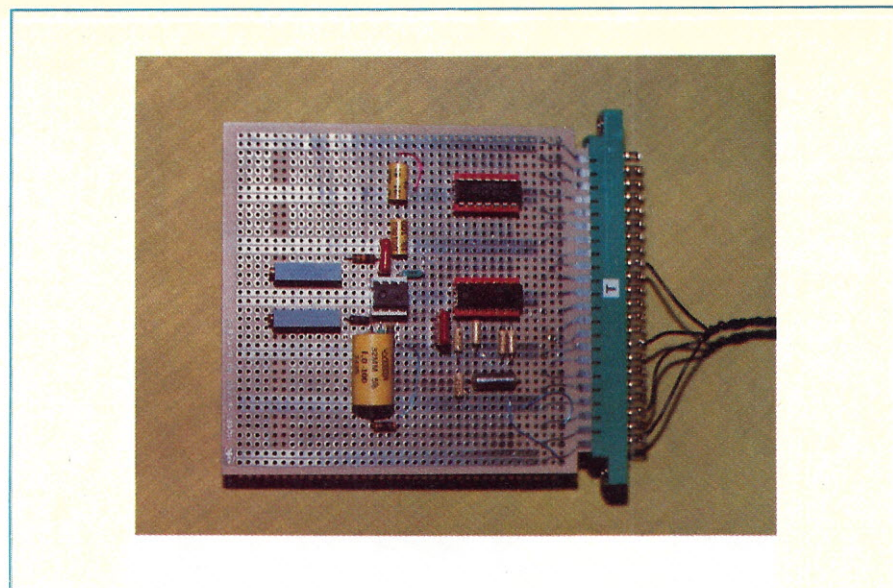


Photo 2. Temperature-to-frequency conversion circuit using the LM331 voltage-to-frequency converter and low temperature coefficient components. The LM334 temperature transducer (not shown above) is located remotely from the board.

through the polling loop a fixed number of times, taking up a total of one second. Dummy timing steps are used so that the polling loop takes the same number of machine cycles independent of whether no level change, a level change or a count is recorded by the computer (Fig. 2).

Another important consideration in measuring frequency with software polling is that the polling loop must repeat fast enough so that level changes are not missed. The flowchart in Fig. 2 includes temperature (frequency divided by a scaler) measurement and output of minimum, present and maximum temperature since last reset. This scheme can be applied to any computer that will run machine code routines, and has at least one bit of input port and a

means of displaying results.

Listing 1 gives the detailed Motorola 6800 listing for the MEK6800D2 kit. The software timing and counting loops are based on the system's .6144 MHz clock frequency. The system 6821 peripheral interface adapter is buffered and drives the displays (seven segment LEDs) on the D2 kit. The program uses two of these displays to output temperature readings. Bit 7 (PA7) of the user 6821 peripheral interface adapter is used to input the frequency signal, since bit 7 is easily tested in 6800 systems.

The program is position independent, meaning it can be relocated in memory without any changes. Thus, permanent storage can be accomplished by simply loading the pro-

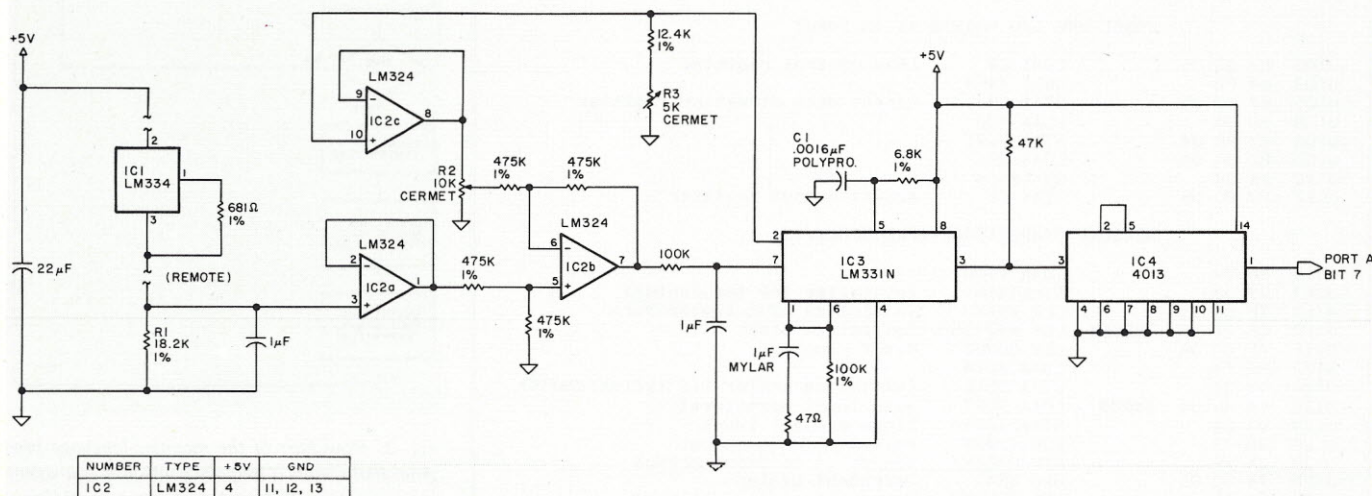


Fig. 1. A circuit which outputs a frequency equal to degrees Fahrenheit times ten.



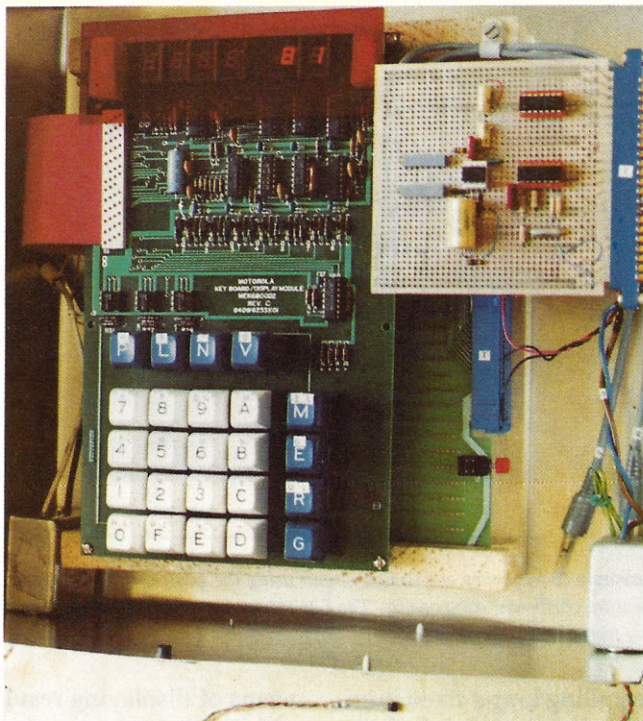


Photo 3. The complete temperature monitoring system. The MEK6800D2 computer kit and temperature to frequency conversion circuit are in an aluminum box (cover removed) with radio frequency suppressors leading to external power supply and temperature transducer connections to eliminate interference with television stations. The temperature transducer is in the foreground.

Listing 1. The 6800 assembly listing for a thermometer which displays the present temperature as well as the minimum and maximum temperatures since last reset.

#### SYMBOL TABLE

TMIN	= \$0000	Minimum temperature
TMAX	= \$0001	Maximum temperature
IPRES	= \$0002	Present input level
IPREV	= \$0003	Previous input level
COUNT	= \$0004	Count & present temperature
SCAL	= \$0005	Scaler
TBUFF	= \$0006	Temporary storage for temperature
DIG1	= \$0007	Digit 1 buffer
DIG2	= \$0008	Digit 2 buffer
PORT	= \$8004	I/O port A & data direction register
CR	= \$8005	Control register A

#### CONFIGURE I/O PORT A AS AN INPUT

```

0100 B6 80 05    LDAA CR        Load control register
0103 84 FB       ANDA #$FB
0105 B7 80 05    STAA CR        Access data direction register
0108 86 00       LDAA #00
010A B7 80 04    STAA PORT
010D B6 80 05    LDAA CR
0110 8A 04       ORAA #$04
0112 B7 80 05    STAA CR        Access output register

```

#### MEASURE TEMPERATURE (FREQUENCY/10)

```

0115 86 99       LDAA #$99
0117 97 00       STAA TMIN
0119 7F 00 01    CLR TMAX      Initialize high temperature
011C CE 27 58    TMESET LDX #$2758 Initialize timer
011F 7F 00 04    CLR COUNT     Reset counter
0122 86 14       LDAA #S14
0124 97 05       STAA SCAL      Initialize scaler (10 cycles/count)
0126 B6 80 04    LDAA PORT      Read input port level
0129 97 02       STAA IPRES     Store present input
012B 98 03       EOR IPREV      Poll for input change
012D 2A 12       BPL DELAY1     Branch if no input change
012F 7A 00 05    DEC SCAL       Decrement scaler
0132 26 11       BNE DELAY2     Branch if scaler not zero
0134 86 14       LDAA #S14
0136 97 05       STAA SCAL      Set scaler
0138 96 04       LDAA COUNT

```

More →

gram (Listing 1) into EPROM and using one of the extra EPROM sockets on the D2 kit.

### Final Comments

By insulating the transducer with plastic tubing and immersing it in water of varying temperature, I found that the temperature readings were well within the accuracy of a common household thermometer for the full 32 degrees F to 158 degrees F operating range of the transducer. Extended range versions of the transducer (LM134, LM234) are available if larger temperature ranges are re-

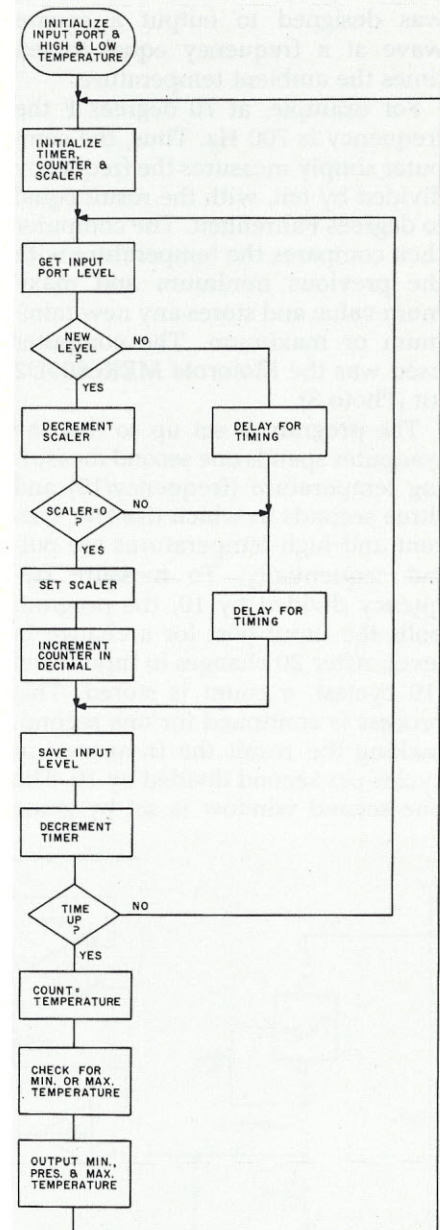


Fig. 2. Flowchart of the machine-language program that counts a frequency which is equivalent to temperature. The present temperature and maximum and minimum temperature since last reset are displayed.



Listing 1 continued.

```

013A 8B 01      ADDA #501
013C 19         DAA      Increment count in decimal
013D 97 04      STAA COUNT Store count
013F 20 0A      BRA CONT  Branch to CONT
0141 A1 00      DELAY1 CMPA 0,X
0143 A1 00      CMPA 0,X  Dummy steps for timing
0145 6D 00      DELAY2 TST 0,X
0147 6D 00      TST 0,X
0149 6D 00      TST 0,X  Dummy steps for timing
014B 96 02      CONT  LDAA IPRES
014D 97 03      STAA IPREV Store input
014F 09         DEX      Decrement timer
0150 26 D4      BNE INPUT Recycle if time not up

CHECK FOR MINIMUM OR MAXIMUM TEMPERATURE
AND DISPLAY RESULTS

0152 96 04      LDAA COUNT Load count (temperature)
0154 91 01      CMPA TMAX  Compare temperature to previous max.
0156 25 02      BCS CHKMIN Branch if not max. temperature
0158 97 01      STAA TMAX  Store new maximum temperature
015A 91 00      CHKMIN CMPA TMIN Compare temperature to previous min.
015C 24 02      BCC OUTPUT Branch if not min. temperature
015E 97 00      STAA TMIN  Store new minimum temperature
0160 96 00      LDAA TMIN  Load minimum temperature
0162 8D 0D      OUTPUT BSR DISPLY Branch to display subroutine
0164 96 04      LDAA COUNT Load present temperature
0166 8D 09      BSR DISPLY Branch to display subroutine
0168 96 01      LDAA TMAX  Load maximum temperature
016A 8D 05      BSR DISPLY Branch to display subroutine
016C 20 AE      BRA TMESET Go to next measurement
016E 01         NOP
016F 01         NOP
0170 01         NOP

DISPLAY SUBROUTINE (CONVERTS BINARY CODED
DECIMAL TO SEVEN SEGMENT OUTPUT)

0171 97 06      DISPLY STAA TBUFF Store temperature
0173 84 0F      ANDA #50F  Mask upper 4 bits
0175 4C         INCA
0176 CE E3 C9   INCX1  LDX #5E3C9 Load X with digit table address - 1
0179 08         INX
017A 4A         DECA      Set pointer to 7 segment digit
017B 26 FC      BNE INCX1
017D A6 00      LDAA 0,X  Load 7 segment digit
017F 97 07      STAA DIG1  Store temperature (low digit)
0181 86 04      LDAA #504
0183 74 00 06   SHFTBF LSR TBUFF
0186 4A         DECA
0187 26 FA      BNE SHFTBF Get temperature (high digit)
0189 96 06      LDAA TBUFF Load temperature (high digit)
018B 4C         INCA
018C CE E3 C9   INCX2  LDX #5E3C9 Load X with digit table address - 1
018F 08         INX
0190 4A         DECA      Set pointer to 7 segment digit
0191 26 FC      BNE INCX2
0193 A6 00      LDAA 0,X  Load 7 segment digit
0195 97 08      STAA DIG2  Store temperature (high digit)
0197 CE 2A 00   DISOUT LDX #52A00 Load output delay
019A 96 07      LDAA DIG1  Load segments (low digit)
019C B7 80 20   STAA $8020 Segments into display port
019F 86 01      LDAA #501
01A1 B7 80 22   STAA $8022 Enable digit 1 cathode (port)
01A4 20 03      BRA $03   Delay for brightness
01A6 01         NOP
01A7 01         NOP
01A8 01         NOP
01A9 7F 80 22   CLR $8022 Disable digit 1 (cathode)
01AC 96 08      LDAA DIG2  Load segments (high digit)
01AE B7 80 20   STAA $8020 Segments into display port
01B1 86 02      LDAA #502
01B3 B7 80 22   STAA $8022 Enable digit 2 (cathode)
01B6 20 03      BRA $03   Delay for brightness
01B8 01         NOP
01B9 01         NOP
01BA 01         NOP
01BB 7F 80 22   CLR $8022 Disable digit 2
01BE 09         DEX      Decrement timer
01BF 26 D9      BNE DISOUT Branch if time not up
01C1 39         RTS      Return to main program

```

7 SEGMENT DIGIT TABLE IN JBUG MONITOR

DIGITBL	\$40	0
E3CA 40	\$79	1
E3CB 79	\$24	2
E3CC 24	\$30	3
E3CD 30	\$19	4
E3CE 19	\$12	5
E3CF 12	\$02	6
E3D0 02	\$78	7
E3D1 78	\$00	8
E3D2 00	\$18	9
E3D3 18		

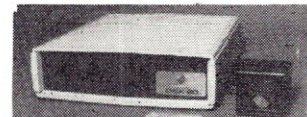
quired. For applications where rapid temperature measurement is needed, a method using a standard eight-bit analog-to-digital converter would be required.

The temperature measurement method described in this article could be used in more complex applications such as temperature controllers or home energy management.

For a stand-alone system, the MEK6800D2 kit could be replaced by a small 6802, 6821 board such as the one described by Peter Stark in the June 1980 issue of *Microcomputing* ("Kilobaud Classroom," p. 22). Since both systems use the 6821 peripheral interface adapter for input-output and run 6800 code, this would be very straightforward. The addition of two seven-segment displays and drivers to the 6802, 6821 board and minor software modifications is all that would be required.

The LM331 voltage-to-frequency converter is available from Priority One Electronics and Jameco Electronics. The LM334 temperature transducer-current source can be purchased from Radio Shack, Jameco or Digi-Key. ■

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# Pascal Means Business

By Mark J. Borgerson

**P**ascal should be the language of choice for anyone writing or using microcomputer programs in business—and I'm going to prove it to you.

Why Pascal? For the sample programs listed here, I couldn't have done it any other way.

First, Pascal gives me more memory space and a more compact code to run in that space—allowing larger data arrays to be kept in memory.

Second, it gives me more data space per diskette—140K per diskette vs 110K in BASIC with Apple DOS 3.2. It also permits much more efficient use of the storage space.

And third, Pascal allows faster execution, important in such tasks as sorting client names alphabetically.

These qualities benefit both the programmer and the user. Other advantages, primarily for the programmer, are that:

- Structured programming is supported, even required (unless you change compiler options).
- Data structures can be defined by the programmer.
- A good editor and file-handling system is available to make writing and altering source code more convenient than is the case with Applesoft BASIC.

The sample programs will help you if you are a programmer. If you are a businessman, the main points of interest will be the descriptions of the

operator interface, the storage capacity and the cost.

I have a suggestion for the latter group. Read the article, and then find a competent programmer. Show him the sample programs and ask whether they make any sense without the explanatory text. If the programmer asks, "Uh, what language is this written in?", start looking for another programmer. If the programmer is a relative, spouse or friend, buy them a good book on UCSD Pascal. There's a list of recommended reading at the end of the article.

## CFILE

The CFILE programs are designed to help a representative of a brokerage house keep track of his clients and their transactions. In essence, they replace an address book and a number of transaction record books.

Like any other set of data-base management programs, the CFILE system has three main parts:

- Procedures to let the user enter information into the system.
- Procedures for processing and storing the entered information.
- Procedures for recalling information desired by the operator and presenting it either on the visual display or the line printer.

Unlike a general-purpose data-base management program, the CFILE programs include only those types of data that will be used by the broker's

representative. The programs can't be used with completely different types of data or functions. The customer gets a program that does what he or she requires without paying (in increased program size or reduced efficiency) for the ability to balance Sally's checkbook or keep track of Jim's recipe file.

Of course, in many personal and some business applications, there is something to be said for the ability to sell the same program several hundred times, thus cutting the cost per copy. One of the major advantages of business programs written in Pascal is that you will soon be able to find a data-base management program which very nearly fits your requirements, and then hire a programmer to make the changes needed to make the result *exactly* what you need.

Which brings up a point: If you can afford it, hire a programmer to make the computer do things your way! If you can spend \$5-15,000 for hardware, you can pay a programmer \$2-4000 to make sure that the hardware does what you want it to do.

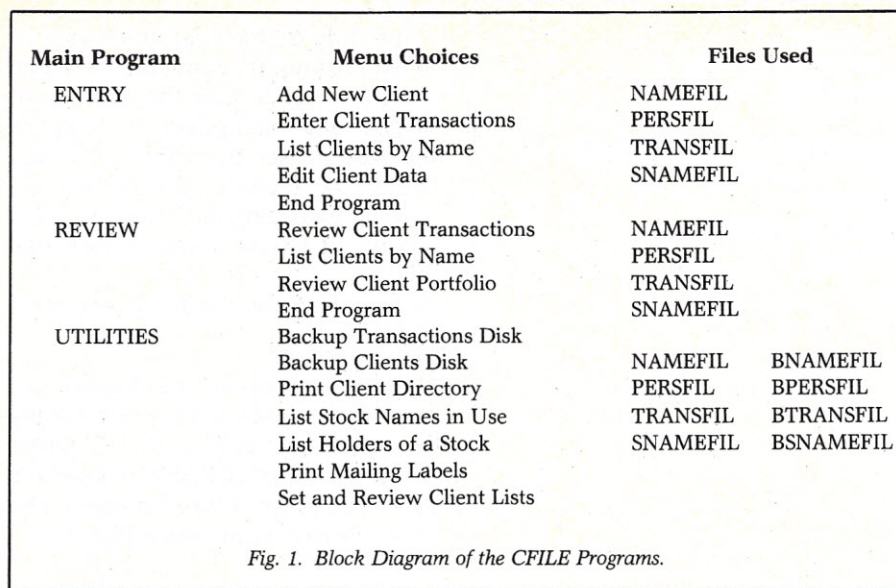
The inventory management requirements of a TV and stereo shop are quite different from those of a jewelry store. No one program can serve both interests with maximum

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*Address correspondence to Mark J. Borgerson, 2015 NW Circle Blvd., Corvallis, OR 97330.*

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efficiency. Automating any record-keeping procedure is going to be a lot of work. Why make things more difficult by having to learn someone else's terminology and operating methods?

The CFILE program system has three major segments, shown in Fig. 1 with the program operations they support. Each is run as a separate program, but all three use the same data base and all agree on the types of data in the files.

The data is stored on two floppy diskettes. One contains the information on the clients, such as names, addresses and telephone numbers. The other stores the transactions for the clients and a list of the stock names used in the transactions.

Since the customer has only two disk drives, both of which are used for data while a program is running, the programs will prompt him to put the program diskette back into one of the drives when switching from one module to another. The programs will now allow the following amounts of data to be stored on a single set of diskettes:

Maximum number of clients:	750
Maximum total transactions (for all clients):	4500
Total number of different stock names:	1000

After six months of use, the diskettes contain about 400 clients, 1800 transactions and 390 different stock names on the data diskettes.

A frequent argument against Pascal is that its input/output abilities are insufficient for many tasks. Before the UCSD version let the language use variable-length character strings and

read and write random-access files, I might have agreed. But the I/O capabilities of Apple Pascal are now every bit as good as those of Applesoft BASIC. In fact, I know one Apple user who has an external terminal, a line printer, dual disk drives, a modem and a digital plotter. He happily uses all these peripheral devices with Pascal—in fact, he reports that he seldom uses BASIC at all. He says it's too difficult keeping track of all the peripherals in BASIC.

It is true that Apple Pascal places some constraints on which peripherals may be placed in which slots in the motherboard. But this seldom turns out to be a problem in business applications.

In terms of the type of input/output most immediately visible to the business user—keyboard input and video output—Pascal is at least equal to BASIC. The Pascal operating system lets the programmer collect data from the keyboard, check it for errors and put the information on the video screen with all the flexibility allowed by BASIC.

Inputting a number in Pascal with strict checking for legal characters (0 to 9, +, - and .) does require a fair amount of source code. However, that code need be written only once. The key to the error-checking in this code is the ability to define the set of characters which are legal in the entry of a number. Compare the BASIC and Pascal listings in Example 1.

Both examples have adequate error-checking and both can be understood from the comments in the source code. With examples of this

length, there is little difference in clarity. There is one big advantage to the Pascal code—it can be reused in any program without change. You simply use your text editor to insert the code into your source file. To use the BASIC version, you would probably have to change the line numbers and make sure that no other part of the program uses the variable A\$—or if it is used, that it is OK to mess it up a little.

I have only a little to say about formatting output to the video display. From the programmer's point of view, output formats will always be a large part of his work. Apple Pascal makes some things easier and some things more difficult than Applesoft. For instance, Pascal has no intrinsic tab function. It is possible to write a general-purpose tab function, but I found it easier to simply build up an output line piece by piece. Pascal allows better control of integer and real number output formats than does Applesoft. For instance, the statement

```
WriteLn('A = ',A:8:2);
```

will write the value of A in a field eight spaces wide with two digits after the decimal point. The Applesoft code to accomplish the same result is considerably more complex. A very important feature of Apple Pascal when writing business programs is the ability to store integers of impressive size. It is possible to define an integer variable with as many as 36 digits. In business programs an integer length of 11 digits lets you use numbers up to 999 million dollars without losing any pennies in roundoff errors. Applesoft programmers start losing their cents at this point.

The time has come to discuss the greatest strength of Pascal—the ability to create special types of variables to fit specific program requirements. I'll start with a simple example: a calendar date in the form mm/dd/yy. We see dates in this form every day, but we don't always consider the possible ways in which a computer might store this information. There are a number of possible alternative storage formats. First, we might simply store the date as a string. This would generally require eight bytes (maximum) for the characters and one byte to define the length of the string. Another alternative (in both BASIC and Pascal) is to store the month, day and year as separate integers. This would reduce the storage needed to six bytes, two for each integer (I am ignoring for the moment any variable



### BASIC

```

10 REM GET KEYBOARD ENTRY AND CHECK TO SEE IF
20 REM IT IS LEGAL FOR NUMERIC ENTRY.
30 GET A$
40 IF ASC(A$)>ASC("0") AND ASC(A$)<ASC("9") THEN GOTO 100
50 IF A$=" " OR A$="-" OR A$="." THEN GOTO 100
60 REM YOU GET HERE ONLY IF ERROR
70 REM BEEP SPEAKER AND RETURN NULL STRING
80 A$=CHR$(0):PRINT CHR$(7):RETURN
100 REM LEGAL CHARACTER
110 RETURN

```

### Pascal

```

function GETNUMCHAR:char;
(* returns a valid numeric character *)
(* or a null if invalid entry *)
var numset:set of char;
    achar:char;
begin
    numset:={ '0'..'9','+','-','.' };
    read(keyboard, achar);
    if achar in numset then
        getnumchar:=achar;
    else
        begin
            write(chr(7)); (*beep speaker*)
            getnumchar:=chr(0); (*return a null*)
        end;
    end; (*getnumchar*)
end;

```

Example 1.

name storage and pointers). If we were really desperate for more efficient storage, we might use some packing technique, such as  $MD\% = 1000 * MM + DD$ , to pack both the month and day into a two-byte integer. If we do much manipulation of the date information, the computational overhead may become significant.

Pascal allows us a much more convenient way to manage date information. We can simply define a logical record to contain exactly the type of information present in a date. Here is definition of a date record:

```

TYPE
    Month=1..12;
    Day=1..31;
    Year=0..99;

```

```

DATREC=packed record
    mm:Month;
    dd:Day;
    yy:Year;
end; (*DATREC*)

```

In the first part of this variable type declaration we set the allowable limits for the values for each part of a date record. This has two significant effects. First, the program will come to a screeching halt should any part of the date record be outside the defined limits. This forces the programmer to

carefully check each part of the date to see that input is within limits. It also guarantees that no nonsense data will end up in the files.

The second effect of defining the numeric limits is that when the components are made part of a packed record, the compiler will reserve only as much space as is needed to store a number of the defined size. You can see how that affects the date record in Example 2.

As you can see, it is possible to pack a complete date into a single 16-bit data word (Pascal uses the 16-bit word as the smallest possible element of data storage). Furthermore, the Pascal operating system will take care of all the packing and unpacking operations. Oh, I don't mean to say that the computational overhead disappears—it doesn't. It's simply that it is no longer the programmer's concern—the system does it all, and much faster than a BASIC program could. Listing 1 shows the Type and Variable declarations from one of the major sections of the CFILE programs. As you can see, a number of specially defined variable types are used in these programs. I will also discuss the file structures and arrays shown in this listing a little further on

in this article.

Specially defined variable types also lead to another convenience when it comes time to take the data out of storage and manipulate it. Suppose we wish to set the value of a date DATE1 to today's date (which we have already entered from the keyboard). In Pascal it would look like this:

```

(*assume DATE1 has already been defined as a
DATREC*)

```

```

DATE1:=TODAY;

```

All the elements of the date record are transferred by simply referencing the single variable name. Suppose that we were using BASIC to store the date as an array of three integers. The same transfer would look like this:

```

10 FOR I=1 TO 3
20 DT%(I)=TD%(I)
30 NEXT I

```

Not quite so convenient, is it? And this is the simple example. Let's take a look at an example from the CFILE program. This is the data type created to store the information about a single stock transaction:

```

Type
    Bucktype:Integer[8];
Stockrec=Record
    Numshare :Integer;
    Purdate   :Datrec; (*purchase date*)
    Optdate   :Datrec; (*sale or option
                        close date*)
    Purtype   :Char;    (*cash, option,
                        margin etc.*)
    Cost      :Real;
    Totalval  :Bucktype; (*this can be a big
                        number*)
    Nampnt    :Integer; (*point to stock
                        name record*)
    Owner     :Integer; (*pointer to owner
                        of stock*)
    Link      :Integer; (*next transaction*)
End; (*Stockrec definition*)

```

Once we have defined two variables to be of the type Stockrec, setting one equal to another is as simple as:

```

Stock2:=Stock1;

```

The same data transfer in a BASIC program is going to be quite a bit more complex, especially since the elements of the record are of different types. This would prevent the programmer from using a simple

Element	Limits	# bits needed
Month	1..12	4 (0-15 max)
Day	1..31	5 (0-31 max)
Year	0..99	7 (0-127 max)
		Total bits 16

Example 2.



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loop such as I used in the data example. Consider also that those elements of the Stockrec which are dates are themselves records with more than one element. When it comes to

manipulating complex data records, Pascal is much more powerful than BASIC.

This same convenience also extends to arrays of variables in Pascal.

If we define two arrays to be of the same type such as:

MBDays:Array[1..50] of Birthday;

YBDays:Array[1..50] of Birthday;

then we can transfer the contents of one array to the other with the simple statement:

MBDays:=YBDays;

In the CFILE programs I don't have any occasion to use this facility, but it does make an impressive example of the abilities of Pascal.

Pascal also lets the programmer use much more meaningful names for records and elements of the records. Consider again the date example. An element of that record can be referred to as Date1.MM. It's much easier for me to think of that label as the month part of the variable Date1 than it is to make the same connection with D1%(1). And not only is it easier for me, but I'm willing to wager it would be easier for another programmer saddled with the task of maintaining the CFILE program.

## Storage

Now that I've convinced you that Pascal is admirably suited for the storage and manipulation of complex

*Listing 1. This is the declarations section of the CFILE program. Note that the code is almost self-explanatory. The record structures are clearly defined and can be deduced from the names of their components.*

(\* Declarations part of CFILE program \*)

CONST

```
Maxname = 1000;
Maxtrans = 4500;
Maxsname = 1000;
Namelen = 22;
Acctlen = 5;
Citylen = 25;
Adrlen = 25;
Phonelen = 12;
Snamelen = 20;
Ziplen = 5;
IDlen = 5;
SSNlen = 11;
```

TYPE

```
Bucktype = Integer{8};
Nametype = String{Namelen};
Acctype = String{Acctlen};
Adrtype = String{Adrlen};
Citytype = String{Citylen};
Ziptype = String{Ziplen};
Phonetype = String{Phonelen};
```

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records of the type found in many business applications, I guess I should show you how efficiently you can store these records on diskettes. Another often heard, and justified, criticism of standard Pascal (as defined by Jensen and Wirth) is that the file I/O capabilities are inadequate. Since standard Pascal allows only sequential access to data files, writing data-base management programs is impossible—unless you have enough memory to read the whole file at once. UCSD Pascal has added an input/output procedure named SEEK to the Pascal system. This procedure lets the program have direct access to any record in a data file. With the addition of the file-access procedure and the addition of true text files, it is now possible to use Pascal to carry out all the operations that are possible in Applesoft BASIC with DOS 3.2. (I am purposely omitting any discussion of binary and machine-language files, as they are seldom used in business applications.)

For the moment, I'm going to confine this discussion to the use of TYPED files. These are files that are collections of a specific type of record. The file definitions for a file of friends' birthdays might look like this:

```
Type
  Birthday = record
    Name:string[25];
    Bday:Datrec; (*assume I already defined
                  Datrec*)
  end;
```

```
Var
  BDfile:file of Birthday;
```

At this point we have precisely defined the structure of the Birthday file. In the same manner, I can define a file with a much more complex record structure such as:

```
Transfil:file of Stockrec;
```

A Pascal programmer can examine the type and variable definitions at the beginning of a program and deduce the exact structure of the data in a file. Have you ever tried to do the same with a BASIC program? If you're lucky, the programmer has left a good description of the file structure for you. If not, well good luck—you'll need it!

A second significant advantage of the Pascal structured file is that each record requires exactly the same amount of disk space as it does memory space. Each record is saved on diskette as a binary image of the record in memory. This is, unfortunate-

*Listing 1 continued.*

```
Stattype = (Indiv,JTROS,Partner,Corp,Trust,
            Keogh,New,Retire);
Stockname = String{Snamelen};
Stockid = String{IDlen};

Month = 1..12;
Day = 1..31;
Year = 0..99;

SetofCHAR = Set of CHAR;

Datrec = Packed Record
  MM:Month;
  DD:Day;
  YY:Year;
End;

Namrec = Record;
  Name:Nametype;
  Acctnum:Acctype;
  Tpoint,Spoint,Ppoint:integer;
end;

Persrec = Record
  Address:Adrtype;
  City:Citytype;
  Zipcode:Ziptype;
  Bphone:Phonetype;
  Hphone:Phonetype;
  SSN:String{SSNlen};
  Lastact:Datrec;
  Status:Stattype;
end;

Stockrec = Record
  Numshare:Integer;
  Purdate:Datrec;
  Optdate:Datrec;
  Purtype:CHAR;
  Cost:Real;
  Totalval:Bucktype;
  Nampnt:integer;
  Owner:integer;
  Link:integer;
end;

Transrec=Stockrec;

Stnrec = Record;
  ID:Stockid;
  NM:Stocknam;
end;

Srckey = Record;
  Mainkey:String{10};
  Minorkey:String{5};
  Nampoint:Integer;
end;
```

VAR

```
Namefil : File of Namrec;
Persfil : File of Persrec;
Transfil : File of Transrec;
Snamefil : File of Stnrec;

Stnam : Stnrec;
Thisper : Persrec;
Thisnam : Namrec;
Thisstock: Stockrec;
Thistrans: Transrec;

Today : Datrec;

Astring,Bstring : String;
Xlin,Ylin,Nrec,I,J,K,Recnum,Nextrec: Integer;

CH,Selection: CHAR;
OKset:Set of CHAR;

SNarray:Array{1..Maxsname} of Stockid;
```



ly, not true in Applesoft BASIC (other versions of BASIC do allow the storage of data in memory image form). With Applesoft a date record consisting of three integers, MM%, DD% and YY%, would require six bytes of memory space but might require as much as nine bytes of diskette space since it would be written out as 12(CR)31(CR)80(CR). In Applesoft, each numeric item is actually written to the disk as a string, and a delimiter (usually a carriage return) is needed to separate the data items. The ability to store data records on diskette in memory image format can more than double the amount of data which can be saved in a given amount of file space. You should also remember that the Pascal diskette format allows about 30 percent more storage space per diskette than DOS 3.2.

There are five basic operations on typed files:

● **RESET**(BDfile, 'MarkDisk:MarkB-Days') opens a data file where BDfile is a file which has been defined in the variable declarations of the programs and MarkBDays is the name of a file on the diskette MarkDisk. (In the Pascal operating system,

each diskette is given a volume name.)

● **SEEK**(BDfile, Recnum) positions a file access pointer to the record number defined by Recnum (Recnum must be an integer). This addition to standard Pascal allows random access to data files.

● **GET**(BDfile) transfers the record pointed to by the access pointer to a special variable of the type Birthday which is called the Window Variable. You can then manipulate this variable just like any other Birthday record.

● **PUT**(BDfile) transfers the contents of the window variable to the disk file record pointed to by the access pointer.

● **CLOSE**(BDfile) closes the file and makes sure that any changes in the file data get transferred from the file buffer in memory to the diskette.

In a business program, these file manipulation commands are generally incorporated into procedures which check to see if the required data diskette is in one of the disk drives and prompt the user if the diskette is not available. These file manipulation commands allow the

Pascal programmer to set up sophisticated file structures to exactly suit the needs of a given program. For example, the CFILE programs use the following file structures:

● **NAMEFIL:FILE OF NAMREC;** This file contains client names and pointers to record numbers in the personal data file and the transaction file.

● **PERSFIL:FILE OF PERSREC;** This is the file which holds the personal data on the clients.

● **TRANSFIL:FILE OF STOCKREC;** This is the file of transactions. The file is a series of linked-list structures. The name record for each client contains a pointer to the first transaction in the client's list.

● **SNAMEFIL:FILE OF STNREC;** Stock names and their abbreviations are kept in this file.

The Name file can be thought of as a key file. When searching for data pertaining to a particular client, the program searches this file (or an image of it in memory) for a match to the required name. When a match is found, the location of the personal data record and the start of the transaction list are taken from the client's Name record. The transactions are saved in a linked-list structure so that each client may have a different number of associated transactions without requiring enough disk space to save the maximum number of transactions for all the clients. The details of linked-list file structures and their advantages and disadvantages are beyond the scope of this article.

The UCSD Pascal system also lets the programmer regard any data file as an unstructured set of blocks of 512 bytes each. This ability is particularly useful when you want to copy the entire contents of one file into another file without worrying about the exact contents of the first (this is known as backing up the data file).

Since the program does not need to break the file blocks up into individual records, the read and write procedures are done much more rapidly. In fact, it is possible to back up the full transactions diskette in about 1.5 minutes. Copying the files record-by-record requires about five times as long.

The backup procedure used in BASIC programs generally requires you to initialize and copy a complete diskette. This may require as many as five minutes per diskette. In addition, the only way to copy a given file

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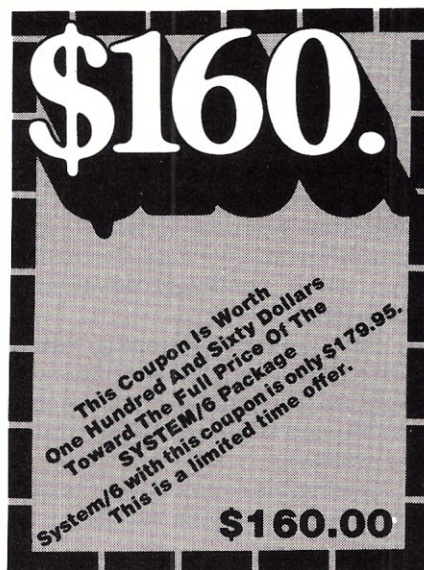
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without destroying others on the backup diskette is to copy the file record-by-record. Believe me, this can get slow!

### Conclusions

If I haven't convinced you by now that there are some real advantages to writing microcomputer business programs in Pascal, I'm going to consider you a reactionary BASIC diehard. This puts you in nearly the same category as the IBM salesman who was rumored to have said, "Those PDP-11s are just toys. You'll never be able to do any serious business computing with those minicomputers!"

For those of you who are only skeptical or who skimmed the article, I'll reiterate the main points. If you are considering business software for a microcomputer, give Pascal a chance. It has some significant advantages over BASIC:

1. Structured programming, which leads to more precise definition of data types, programming approaches and software solutions to your business problems.

2. Intelligible source code, the best way to guarantee your program can

be maintained when your programmer decides he'd rather write magazine articles.

3. Efficient use of memory resources for the storage of data. No computer ever has enough memory. With Pascal you can store more data in less. With luck, it will take you another year to outgrow your computer.

4. The ability to manipulate grouped data items as a single record. The less time your programmer spends writing code to move data, the more time he can spend making it easier for you to get information into and out of the computer.

5. More efficient ways to store data on your diskette (see 3).

6. Programs which run more quickly. If your program was written in Pascal, you'd only have time to skim this article while the customer file was sorting. If you're still using BASIC, go back to the beginning and read the article again. You'll have time! ■

### References

*Problem Solving Using Pascal* by Kenneth L. Bowles. A good introduction, but the emphasis is on examples suit-

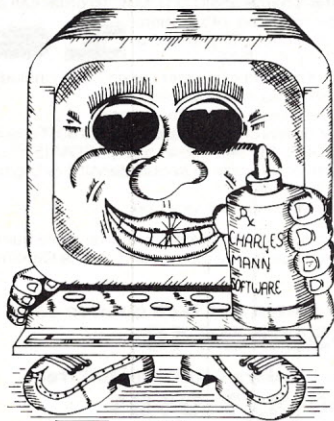
ed to college students.

*PASCAL User Manual and Report* by Kathleen Jensen and Niklaus Wirth. The authoritative definition of the Pascal language. Doesn't mention UCSD extensions to language. Give this one to your favorite programmer. (This one and *Problem Solving* come with the Apple Pascal package.)

*Programming in Pascal* by Peter Grogono. Slightly more advanced than Bowles' book. Several excellent examples of linked list structures and I/O procedures. I particularly liked the part about record structures.

*Algorithms + Data Structures = Programs* by Niklaus Wirth. A much more advanced work. For programmers only. Good sections on sets and sorting arrays. About 150 pages on tree structures and sentence parsing, which I haven't found any use for in business programs.

*Beginner's Guide for the UCSD Pascal System* by Kenneth Bowles. If you want to convert a programmer, buy this book, the accompanying program disk and an Apple Pascal system. The book assumes only that you can read, have a system to work with and want to learn.



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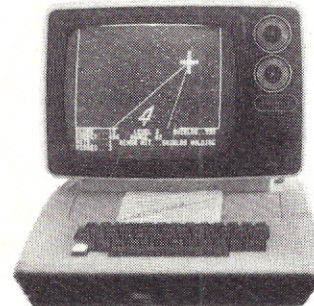
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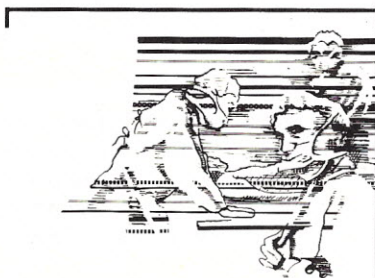
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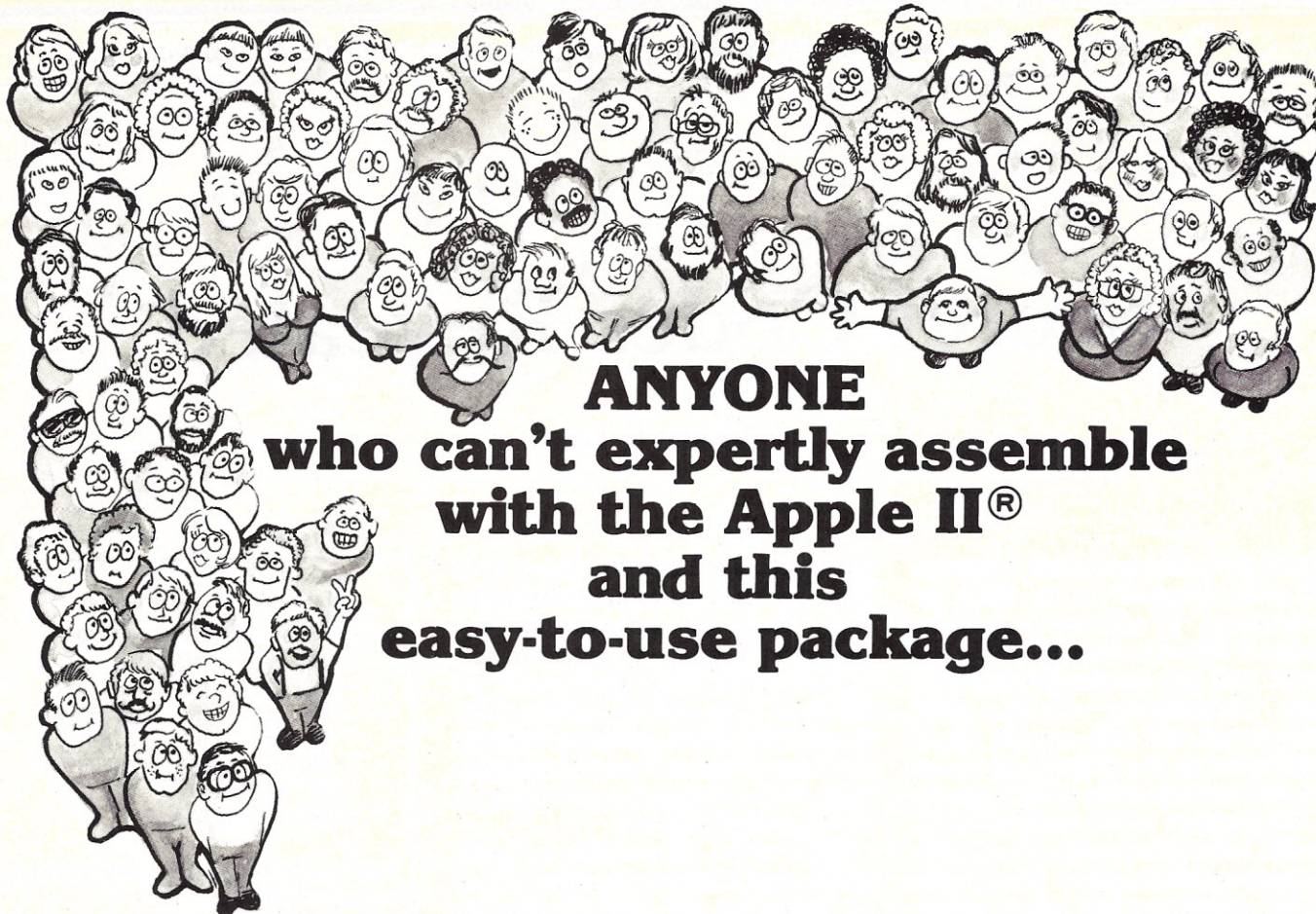
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# Secret Codes Revealed

By Edwin E. Freed

The Z-80 microprocessor was originally designed as an 8080 enhancement. In addition to running faster, it added a number of new features, and yet maintained machine-code compatibility with the 8080. This meant that only unused operation codes on the 8080 could be expanded to implement these features.

The purpose of this article is to describe how these codes were used. Undocumented codes have been found which you can use to advantage. Manipulation of the halves of the IX and IY registers, additional rotate instructions and some duplication of instructions have also been uncovered.

Some of the operation codes found here are not officially documented or supported by the manufacturer; such codes are underlined in the tables. These undocumented operations have been tested and found to work on Zilog Z-80 and Z-80A chips. However, there is no guarantee that these codes will continue to function on future generations of the Z-80.

On any eight-bit processor, there are 256 possible first bytes for in-

structions. On the 8080, all but 12 of these are used. In valid 8080 instructions, there are no undocumented codes that result from values in successive bytes of the instructions. To maintain 8080 software compatibility, all of the Z-80's additional features use these 12 codes. Some of the codes have been expanded to as many as four-byte instructions.

Eight of the 12 available op codes implement a single operation (Table 1). These are the relative jump instructions and the register bank exchange operation, which could have been packed into a single op code, of course, but only at the expense of adding an extra byte to the instructions.

To be useful, the relative jump instructions must be two-byte. A three-byte relative jump would offer no space savings over the traditional absolute jump of the 8080. The only gain would be some relocatability of the machine code.

The register bank exchange instructions manipulate the Z-80's alternate register set. Since these instructions are primarily intended for

Hex code	Instruction
08	EX AF, AF'
10 ee	DJNZ E
18 ee	JR E
20 ee	JR NZ, E
28 ee	JR Z, E
30 ee	JR NC, E
38 ee	JR C, E
D9	EXX

Table 1. The Z-80's relative jump and bank exchange instructions.

fast interrupt processing, it is crucial that they be one-byte in order to execute as quickly as possible.

In the implementation of the Z-80, additional 16-bit index registers IX and IY were added. Two operation codes, DD and FD, provide instruction set support. The designers of the Z-80 added the new index registers simply: the IX and IY instructions consist of DD or FD followed by an instruction which refers the HL register pair. For example, the code to load HL immediate (LD HL,nn) is 2A nn; the instruction LD IX,nn is DD 2A nn. The equivalent IY instruction is FD 2A nn. In either case, the two-byte operand nn immediately follows the instruction.

When an instruction that uses HL as an indirect memory pointer is prefaced with DD or FD, something different happens. An additional byte is required in the instruction. The value of this byte, called the displacement, is added to the IX or IY register. This

0000	24	INC	H	;Increment H
0001	DD24	INC	HX	;Increment top half of IX
0003	2D	DEC	L	;Decrement L
0004	FD2D	DEC	LY	;Decrement bottom half of IY
0006	8C	ADC	A,H	;Add with carry H to A
0007	FD8C	ADC	A,HY	;Add with carry HY to A
0009	AD	XOR	A,L	...
000A	DDAD	XOR	A,LX	
000C	B5	OR	A,L	
000D	FDB5	OR	A,LY	

Listing 1. A sampling of instructions referencing IX and IY as four eight-bit registers. The format is that of a typical assembly-language listing. First, an instruction which operates on H or L is shown, then a analogous instruction for an index register.

Address correspondence to Edwin E. Freed, Platt Campus Center, Harvey Mudd College, Claremont, CA 91711.



		High order 5 bits of second byte					
		00	08	10	18	20	28
L o w o r d e r	0	RLC B	RRC B	RL B	RR B	SLA B	SRA B
	1	RLC C	RRC C	RL C	RR C	SLA C	SRA C
	2	RLC D	RRC D	RL D	RR D	SLA D	SRA D
	3	RLC E	RRC E	RL E	RR E	SLA E	SRA E
	4	RLC H	RRC H	RL H	RR H	SLA H	SRA H
	5	RLC L	RRC L	RL L	RR L	SLA L	SRA L
	6	RLC (HL)	RRC (HL)	RL (HL)	RR (HL)	SLA (HL)	SRA (HL)
	7	RLC A	RRC A	RL A	RR A	SLA A	SRA A
		30	38	40-7F	80-9F	A0 - FF	
b i t s	0	<u>RLO</u> B	SRL B	BIT b,B	RES b,B	SET b,B	
	1	<u>RLO</u> C	SRL C	BIT b,C	RES b,C	SET b,C	
	2	<u>RLO</u> D	SRL D	BIT b,D	RES b,D	SET b,D	
	3	<u>RLO</u> E	SRL E	BIT b,E	RES b,E	SET b,E	
	4	<u>RLO</u> H	SRL H	BIT b,H	RES b,H	SET b,H	
	5	<u>RLO</u> L	SRL L	BIT b,L	RES b,L	SET b,L	
	6	<u>RLO</u> (HL)	SRL (HL)	BIT b,(HL)	RES b,(HL)	SET b,(HL)	
	7	<u>RLO</u> A	SRL A	BIT b,A	RES b,A	SET b,A	

Table 2. The shift and rotate instructions. The first byte is always CB. Previously undocumented left rotate instructions are underlined. In the bit manipulation instructions, the affected bit b is indicated by bits 3, 4 and 5 in the second byte.

modified value is then used as a memory pointer to obtain the operand.

This technique for using the index register instructions leaves many questions unanswered. For instance, what happens when DD or FD is followed by an instruction which refers to the BC or DE, not the HL register pair? When tested, these instructions functioned normally and acted on the original (not IX, IY) register pair involved. So there are actually many duplicate instructions available, all useless because they are one byte longer than the original instruction.

Prefixing an instruction that references the H or L register with DD or FD can lead to some useful results, however. You can manipulate the high and low halves of the IX and IY registers as easily as any other eight-bit register! (See Listing 1.) If you use an instruction that references as another eight-bit register, like B or E, it

behaves normally.

No new assembly-language instruction mnemonics are needed to allow access to these new instructions. New names which refer to the IZ and IY registers as four eight-bit registers are used. The chosen names are HX, LX, HY and LY. HX refers to the high-order eight bits of IX, LX refers to the low-order eight bits, and so on.

The CB op code group is used to implement the individual register rotate and bit manipulation instructions. Their format is always two bytes, with the first byte being CB, and the second byte indicating both operation and the register affected.

In the decomposition of the CB group (Table 2), only eight instructions were left undefined. Upon testing, these turned out to be a hitherto undocumented form of a left rotate instruction that shifts a one into the low-order bit and moves the high-

order bit into the carry flag. This, in effect, performs a  $2n + 1$  operation on an eight-bit register. The chosen op code for this new function is RLO (ro-

		High order 5 bits of second byte							
		80	88	90	98	A0	A8	B0	B8
L o w o r d b i t s	0	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	LDI	LDD	LDIR	LDDR
	1	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	CPI	CPD	CPRI	CPDR
	2	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	INI	IND	INIR	INDR
	3	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	OUTI	OUTD	OTIR	OTDR
	4-7	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>	<u>NOP</u>

Table 3. The block move/transfer instructions. The first byte of all these instructions is ED.

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tate left, shift in one). The format for this new rotate instruction is exactly the same as for any other in the family.

The ED op code group is used to implement a multitude of Z-80 features. All the block transfer, block search and additional interrupt control functions are included in this group. All instructions consist of ED followed by a single byte to indicate the exact operation. No additional arguments are used. Although 256 new instructions could have been implemented, only 60 of these are actually

defined by Zilog.

It happens that none of the undefined codes in this group do anything useful. The undefined codes 00-3F and C0-FF act as NOPs. Codes in the range 80-BF are used for the block control instructions (Table 3). The remaining codes in the range 40-7F perform a variety of functions. The undefined ones in this group tend to be duplicates of existing codes (Table 4).

It should be noted that prefixing instructions in the ED group with DD or FD will not create a corresponding

IX or IY operation. This is regrettable, but the ED group appears to be the only one so affected.

## Conclusion

It should be possible to modify most Z-80 assembler to accept the foregoing undocumented instructions, if a source to the assembler is available. If not, you can insert the hex codes for the instructions inline as data statements. Code the new index register instructions as DD or FD, followed by the appropriate H or L referencing instruction. ■

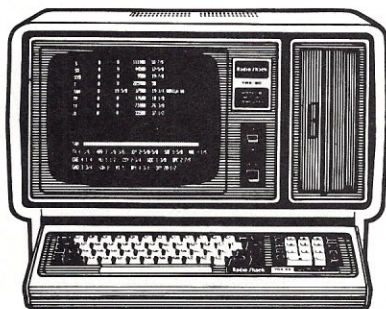
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L o w  o r d e r  b i t s	40		48		50		58		60		68		70		78	
	0	IN B,(C)	IN C,(C)	IN D,(C)	IN E,(C)	IN H,(C)	IN L,(C)	IN (HL),(C)	IN A,(C)							
	1	OUT (C),B	OUT (C),C	OUT (C),D	OUT (C),E	OUT (C),H	OUT (C),L	OUT (C),(HL)	OUT (C),A							
	2	SBC HL,BC	ADC HL,BC	SBC HL,DE	ADC HL,DE	SBC HL,HL	ADC HL,HL	SBC HL,SP	ADC HL,SP							
	3	LD (nn),BC	LD BC,(nn)	LD (nn),DE	LD DE,(nn)	LD (nn),HL	LD HL,(nn)	LD (nn),SP	LD SP,(nn)							
	4	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG							
	5	RETN	RETI	RETN	RETI	RETN	RETI	RETN	RETI							
	6	IM 0	NOP	IM 1	IM 2	NOP	NOP	NOP	NOP							
	7	LD I,A	LD R,A	LD A,I	LD A,R	RRD	RLD	NOP	NOP							

Table 4. Miscellaneous instructions with ED as the first byte. Note that the NOPs in the same row as the IM instructions may have hitherto undiscovered effects on the interrupt system.

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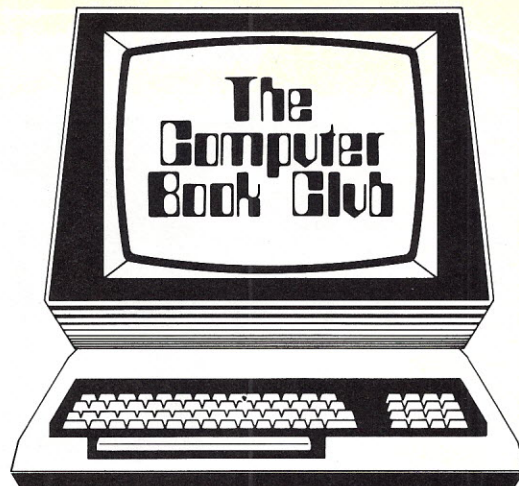
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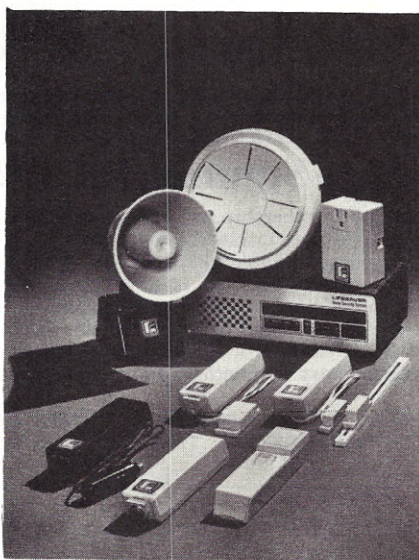
## ORDER ENTRY/ACCOUNTS RECEIVABLE SYSTEMS



*Fyrnetics President, Larry Larsen, and Controller, Dennis Turek, considering some of the features of their new security system.*

generated such a high volume of sales orders and invoices that it became necessary to install a computer system in 1977 in order to handle the multi-million dollar annual sales volume.

"Fyrnetics initially installed a Wang 2200 computer system, equipped with seven CRT terminals, four 10 megabyte hard disk drives, and two line printers at a monthly lease cost of over \$4000.00. By late 1979, the company had invested nearly six man-years in our own software development", comments Fyrnetics president, Larry Larsen "As a part of a cost cutting program, we decided to replace the Wang equipment with a microcomputer system. We reviewed all available micro systems and concluded that the MSI hardware and software packages were best suited to our needs."



**"We were particularly pleased with the system-generation capability of the MSI business packages, which allowed us to utilize our existing continuous form sales orders, invoices, and packing lists.** The requirements for our computer system were rather demanding since we had large customers such as Montgomery Wards and Wicks, each having up to 300 stores. Each store is treated as an individual customer during the order entry and shipping process. However, payment is made from a central accounting office with many stores on a single check. Our system had to allow us to properly credit the payment to many different store locations and invoices. This feature was a part of the MSI Accounts Receivable software package. **Our accounts receivable system handles over 750 regular customers with over 3000 open invoices and 10,000 transactions per month for us."**

*The LIFESAVER line of wireless home security products manufactured by Fyrnetics, Inc. Anyone desiring more information on this interesting product line should contact Fyrnetics, Inc. at the above address.*

**THE COMPANY:  
FYRNETICS, INC.  
1021 DAVIS ROAD  
ELGIN, ILLINOIS 60120  
312-742-0282**

Fyrnetics, Inc. of Elgin, Illinois has grown from a private manufacturer of ionization smoke detectors for companies, such as Sears & Roebuck, to a full line manufacturer of wireless security products which are sold through a worldwide network of dealers and distributors. Since saturation of the residential security market is estimated to be less than 3% in the United States, their major marketing effort has been directed toward distribution through dealers who demonstrate and sell electronic products to the consumer. This marketing approach



*The modern production facility at Fyrnetics, Inc. where wireless home security products are designed and manufactured. The company also has production facilities in Hong Kong where larger quantities of their products are manufactured.*



## CONSIDERATIONS FOR THE SELECTION OF ACCOUNTS RECEIVABLE SYSTEMS

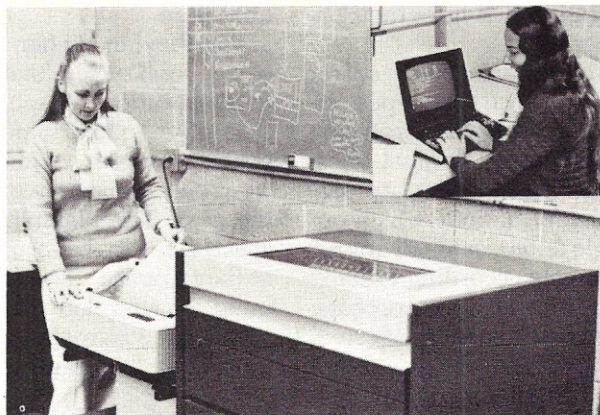
The selection of business computer systems today involves the careful consideration of many different factors. Even though the cost of computer systems has dropped substantially, we considered the selection process to be highly critical to us because of the tremendous need for a highly reliable computer system in our daily operations. Due to our high volume of sales transactions we were highly dependent upon the system for order processing and for information. We considered the following issues to be key to our selection of the MSI system:

**LARGE DATA BASE** - The processing of over 700 orders per month, with 3000 open invoices and 5000 active statement items required that we have easy and efficient on-line access to our large data base. The MSI system provides a large selection of data reports for open orders, backorders, invoices, credit memos, as well as customer statements and account status information.

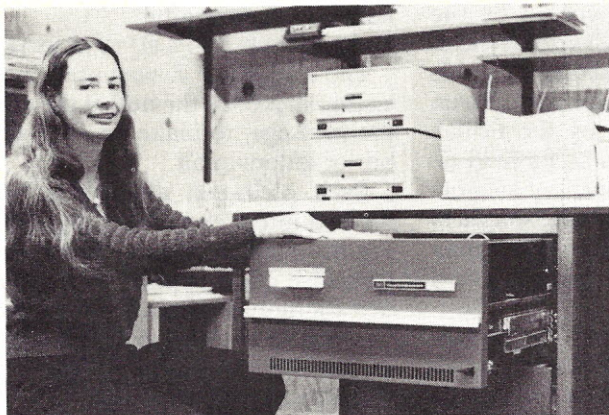
**EFFICIENT PAPERWORK FLOW** - The processing of our large volume of sales orders required an efficient system for printing sales orders, packing lists, invoices, and customer statements. The MSI system offers a convenient system generation program which allows the use of any desired format for pre-printed continuous forms. In addition, packing lists and customer invoices are generated automatically as sales orders are processed.

**GENERAL LEDGER TIE-IN** - Due to the large volume of individual invoices and cash receipts, we required an automatic posting procedure for our general ledger programs in order to minimize the data entry process. The MSI system offers a complete general ledger program package which links automatically to the other business program modules. All invoices, as well as cash receipts, are automatically written to the general ledger posting files from which individual journals are created. This procedure insures the generation of balanced journals and greatly reduces the time requirement for generation of monthly income statement and balance sheets.

**SYSTEM INTEGRATION** - The MSI system is fully integrated. The order entry system is linked to inventory for correct pricing, description of items on order. The inventory system is also linked to general ledger to allow different categories of products sold to be automatically posted to the correct sales accounts. The MSI inventory system provides complete cost accounting information for both labor and material. **The MSI programs provide the big machine capability that we need and yet provide the flexibility that we desire.**



*The MSI computer system drives two line printers at Fyrnetics, Inc.*



*The MSI computer system at Fyrnetics, Inc. employs 10 megabyte hard disk drives to contain the large on-line data base.*

**SUPPORT** - The availability of source listings for all of the MSI business software was an added incentive to select the MSI system. This has allowed us to make some specialized enhancements to our programs easily. **MSI really delivered for us allowing the replacement of an expensive WANG 2200 system with a comparable MSI system at a fraction of the cost.**

If you would like to have more information on MSI business computer systems, call or write, **Midwest Scientific Instruments, Inc., 220 W. Cedar, Olathe, KS 66061, 800-255-6638, Telex 42525(MSI A OLAT).**

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# Crack That Code

By Dr. Richard C. Vile, Jr.

**F**ew people have not at one time or another played with secret messages. Codes and ciphers have been a source of fascination for many centuries. History is filled with many enthralling stories which have their basis in cryptography.

Cryptography deals with secret messages. Of the various types, ciphers and codes are both produced by transforming the original message, or plain text. Ciphers are produced by transformations which operate on single letters or small groups of letters at a time according to some relatively simple algorithmic process. Codes are produced by transformations which usually operate on entire words and sometimes entire sentences at a time. Codes may require elaborate apparatus in the form of code books, and are usually more vulnerable to theft than to analysis. Plain text is transformed into cipher text, the secret message, by the process of encipherment, the application of one or more codes or ciphers. Cipher text is rendered understandable by the inverse process of decipherment.

The term cryptography refers to the processes of enciphering and deciphering messages. Cryptanalysis is the study of the methods used to crack or solve codes and ciphers when the enciphering algorithm is not known. Cryptology refers to the combined sciences of cryptography and cryptanalysis and the study of related techniques.

Most cryptographic techniques rely on a general system and a specific key. The general system is the overall method employed, such as simple substitution, columnar transposition, and so on.

The Playfair cipher is an example of a general system that uses digraphic substitution. A specific key consists of the particular details of the general system, which are varied from one application of the system to the next. The Playfair cipher uses a specific key in the form of a key word or key phrase. The key is used to build a so-called Playfair square, which is a 5×5 rectangular table used in the cryptographic process.

## The Playfair Cipher

This system was invented by the famous scientist Sir Charles Wheatstone, but was popularized by his friend and fellow scientist Baron Playfair. It was used by the British Army for many years as its field cipher, the technique used by soldiers in the field. It is elegant and simple to use, but more difficult to crack than simple monographic (single letter) substitution ciphers.

A Playfair square is a 5×5 square table filled with the letters of the alphabet, except for J (I is substituted for J). Any agreed-upon method of filling in the letters may be used—the only one to avoid is, of course, ordinary alphabetical order. The most common technique is to choose a key word or phrase—for example "MI-

CROCOMPUTERS ARE FUN"—and first fill in the initial part of the square with the unique letters of that key (see Fig. 1). The remaining cells in the square are then filled in with the letters unused in the key, in alphabetical order (see Fig. 2). A good key will have from ten to 15 distinct letters, although any key phrase desired will work.

A message which is to be enciphered using the Playfair square is first split up into successive pairs, or digraphs. Pairs with identical letters are avoided by the insertion of an extra letter called a null. The null may be any letter mutually agreed upon in advance. For example, the plain text "The APPLE II Computer System" would be split up as follows (we capitalize for uniformity):

TH EA PX PL EI IC OM PU TE RS YS TE MX

The null letter X was used in this example. Notice the null at the end of the message, to make an even number of letters in all.

Each plain-text digraph is transformed into a cipher text digraph using the Playfair square. The specific transformation applied to the plain-text digraph depends on the relative position of the letters of the digraph in the Playfair square. There are three distinct possibilities:

- The two letters are in the same row of the square.
- The two letters are in the same col-

*Dr. Richard C. Vile, Jr., 3467 Yellowstone Drive, Ann Arbor, MI 48105.*



TH→UK	EP→SU	LA→GB	YF→WB	AI→FM
RC→OR	IP→MU	HE→LU	RW→IY	AS→DP
AC→NM	TU→ET	AL→BG	LY→YR	IN→CF
VE→YP	NT→KN	ED→SB	BY→LR	SI→UO
RC→OR	HA→GF	RL→EY	ES→SP	WH→IW
EA→PB	TS→EP	TO→SC	NE→BT	

Table 1.

KXJEY UREBE ZWEHE WRYTU HEYFS KREHE GOYAI WTTTU OLKSY  
CAJPO BOTEI ZONTX BYBWT GONEY CUZWR GDSON SXBOU YWRHE  
BAAHY USEDQ

Table 2.

umn of the square.

●The two letters are in different rows and columns.

**Same row.** Replace each plain-text letter of the pair with the one to its immediate right in the same row of the Playfair square. Imagine the row to be circular, so that the rightmost letter of a row will cipher to the first letter of the same row.

**Same column.** Replace each plain-text letter of the digraph by the one directly below it in the same column of the Playfair square. Again, imagine that the columns are circular, so that the bottom letter of each column will cipher to the top letter of the same column.

**Different row and column.** The two letters of the digraph form the opposite corners of a rectangle within the Playfair square. Each letter of the pair is replaced by the letter in the same row of the Playfair square which is one of the other two corners of the rectangle formed.

The methods used to decipher a message are simply the inverse of those just described. Thus, if a cipher-text pair belongs to the same column of the square, it is deciphered by replacing each letter with the one directly above it in the same column, the top letter of any column being replaced by the bottom letter of the same column.

### Examples and Exercises

Using the Playfair square constructed in Fig. 2, now consider the following plain text: The Playfair cipher was actually invented by Sir Charles Wheatstone. The cipher text produced from this message is shown

KEY: MICROCOMPUTERS ARE FUN

M	I	C	R	O
P	U	T	E	S
A	F	N		

Fig. 1. Filling in the KEY letters.

KEY: MICROCOMPUTERS ARE FUN

M	I	C	R	O
P	U	T	E	S
A	F	N	B	D
G	H	K	L	Q
V	W	X	Y	Z

Fig. 2. Completing the Playfair Square.

in Table 1, one digraph at a time:

The circled examples are worked out in detail in Fig. 3.

To enhance your understanding of the Playfair cipher, try the following exercises:

a. Describe precisely the three methods of deciphering individual digraphs.

b. Construct the Playfair square for the following key: ROYAL NEW ZEALAND NAVY.

c. Using the square constructed in b, decipher the message in Table 2 (sent 9:30 AM, August 7, 1943, to report the sinking of John F. Kennedy's PT109). Note that nulls were not used to eliminate double letters in the Table 2 cipher text. In addition, some of the letters may have been garbled in transmission.

### Apple II Playfair Program

Listing 1 presents an Applesoft pro-

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gram that facilitates the use of the Playfair cipher. The user may construct Playfair squares and both enci-

pher and decipher messages. Input and output is quite flexible and allows the following combinations:

Input—Keyboard, file.

Output—Keyboard only; file only; keyboard and file; keyboard and printer; file and printer; keyboard, file and printer.

These options may be dynamically changed during a given program run. The output, whether cipher text or plain text, is formatted in standard cryptographic fashion: groups of five letters, separated by a space.

## Program Notes

Fig. 4 shows the relationships between the various routines of the program. Arrows in the diagram point from a calling routine to a called routine. The numbers above each oval represent the line number at which the corresponding routine begins. Thus, the Gather routine at line 1000 calls the Scan routine at line 2000.

Even though the program is lengthy, a study of the following comments on each routine together with Fig. 4 should suffice to easily understand its operation. Incidentally, the program of Listing 2 presents a condensed version of these notes and should be the program invoked by letter [A] in the master menu of the Playfair program (READ INTERNALS DOCUMENTATION).

1-499—PRELIMS. A couple of one-time-only initializations are performed. Arrays are dimensioned, the function FN M6(A) is defined, and the routines COUT-POKES and INTRO are invoked.

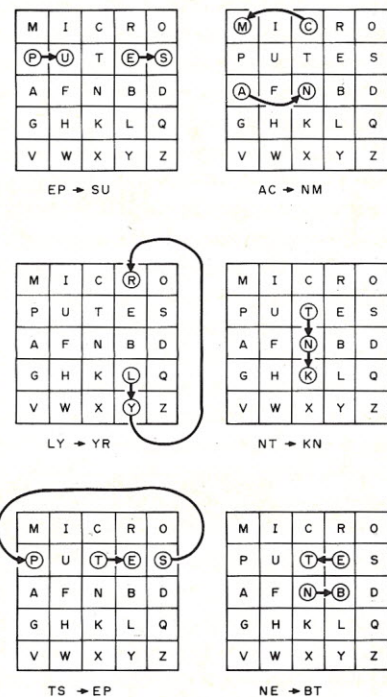


Fig. 3. Plain-text pairs to cipher-text pairs.

Listing 1. Playfair Cipher program.

```

1  REM =====
2  REM =
3  REM =   PLAYFAIR CIPHER   =
4  REM =
5  REM =       BY
6  REM =DR. RICHARD C. VILE, JR.=
7  REM =
8  REM =
9  REM =====
14 DIM PF$(4,4),US(26),ROW(26),COL(26)
15 DEF FN M6(A) = INT ((A / 6 - INT (A / 6)) * 6 + .05) * SGN
    (A / 6)
20 D$ = CHR$(4)
21 HC = 0: REM THIS CANNOT GO IN NORMAL INITIALIZATION ROUTINE
100 GOSUB 9000: REM INTRODUCTION
105 GOSUB 6000: REM SETUP COUT INTERFACE
500 REM MENU ROUTINES
501 REM =====
505 GOSUB 1800: REM INITIALIZE
506 HOME : GOSUB 2700
508 NORMAL : VTAB 5: HTAB 5
510 PRINT "CHOOSE ONE OF THE FOLLOWING:": PRINT
515 NORMAL : HTAB 5
520 POKE 249,219: CALL 250: PRINT "AJ READ INTERNALS DOCUMENTATIO
    N"
521 HTAB 5: CALL 250: PRINT "BJ ENCIPHER TEXT"
522 HTAB 5: CALL 250: PRINT "CJ DECIPHER TEXT"
523 HTAB 5: CALL 250: PRINT "DJ BUILD A NEW PLAYFAIR SQUARE"
524 HTAB 5: CALL 250: PRINT "EJ DISPLAY CURRENT PLAYFAIR SQUARE"
525 HTAB 5: CALL 250: PRINT "FJ TURN ON PRINTER OUTPUT"
526 HTAB 5: CALL 250: PRINT "GJ TURN OFF PRINTER OUTPUT"
527 HTAB 5: CALL 250: PRINT "HJ DISPLAY DISK CATALOG"
528 HTAB 5: CALL 250: PRINT "IJ EXIT"
534 VTAB 18: HTAB 5
535 GET A$:WH = ASC (A$) - ASC ("@" )
536 IF WH = - 61 THEN HOME : END
537 IF WH < 0 THEN 535
539 ON WH GOTO 550,560,570,580,545,590,598,585,599
540 VTAB 18: HTAB 5: FLASH : CALL - 868: PRINT "TRY AGAIN": NORMAL
    : GOTO 534
545 GOSUB 900: GOTO 505
550 PRINT D$
551 PRINT D$:"RUN DOCUMENTATION"
560 IF K2$ = "" THEN FLASH : PRINT "NO PLAYFAIR SQUARE": NORMAL
    : GOTO 534
562 GOSUB 600: REM SET UP ENCIPHER
564 GOSUB 1000: REM DO THE WORK
565 GOTO 505
570 IF K2$ = "" THEN FLASH : PRINT "NO PLAYFAIR SQUARE": NORMAL
    : GOTO 534
572 GOSUB 700: REM MENU FOR DECIPHER
574 GOSUB 1000: REM DO THE WORK
575 GOTO 505
580 GOSUB 800: REM BUILD PLAYFAIR SQUARE
581 GOTO 505
585 REM DISPLAY CATALOG
586 REM
587 HOME : PRINT D$
588 PRINT D$:"CATALOG"
589 GOSUB 1500: GOTO 505
590 REM TURN ON PRINTER AND PUT OUT A FEW BLANK LINES FOR NEATNES
    S
591 HC = 1: PRINT D$: PRINT D$:"PR#1"
592 PRINT CHR$(9);"72N": PRINT : PRINT : PRINT : PRINT : PRINT
593 PRINT D$
594 PRINT D$:"PR#0"
595 GOTO 505
598 HC = 0: GOTO 505
599 HOME : END
600 REM ENCIPHER SETUP
601 REM -----
605 HOME : VTAB 2: HTAB 5: INVERSE : PRINT "ENCIPHERING": NORMAL
606 GOSUB 2700
609 INVERSE
610 VTAB 5: HTAB 5: PRINT "CHOOSE ONE LETTER FROM EACH COLUMN": PRINT
612 NORMAL : HTAB 5: PRINT "INPUT FROM": HTAB 25: PRINT "OUTPUT
    TO": PRINT
615 POKE 249,219: HTAB 5: CALL 250: PRINT "AJ KEYBOARD": HTAB 25
    : CALL 250
616 PRINT "CJ KEYBOARD"
620 HTAB 5: CALL 250: PRINT "BJ FILE": HTAB 25: CALL 250: PRINT
    "DJ FILE"
625 HTAB 25: CALL 250: PRINT "EJ BOTH FILE"
626 HTAB 29: PRINT "AND"
627 HTAB 29: PRINT "KEYBOARD"
629 VTAB 15
630 HTAB 6: GET A$: PRINT A$:W1 = ASC (A$) - ASC ("@" )
632 IF W1 = 1 OR W1 = 2 THEN 635
633 PRINT CHR$(7): GOTO 629
635 VTAB 15: HTAB 26: GET B$: PRINT B$
636 W2 = ASC (B$) - ASC ("@" )
637 IF W2 < 3 OR W2 > 5 THEN PRINT CHR$(7): GOTO 635
640 IP = W1: REM INPUT SWITCH
642 OP = W2 - 2: REM OUTPUT SWITCH
645 PR = 1: REM PROCESS SWITCH - INDICATES ENCIPHERMENT

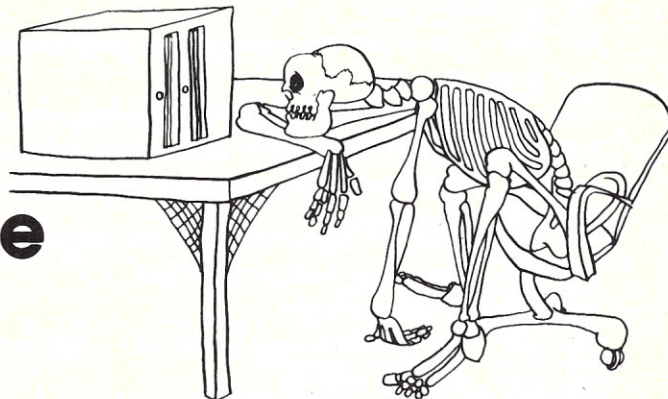
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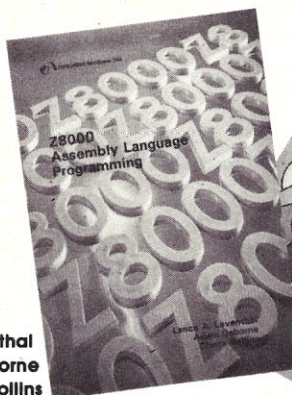
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Listing 1 continued.

```

650 IF IP = 2 OR OP = 2 OR OP = 3 THEN GOSUB 1600: REM OPEN FILE
    ES
655 PRINT : HTAB 5: FLASH : PRINT "TO STOP ENCIPHERING, END"
656 HTAB 5: PRINT "INPUT LINE WITH A CONTROL-Z"
690 GOSUB 1500
699 RETURN
700 REM DECIPHER SETUP
701 REM -----
705 HOME : VTAB 2: HTAB 5: INVERSE : PRINT "DECIPHERING": NORMAL

706 GOSUB 2700
709 INVERSE
710 VTAB 5: HTAB 5: PRINT "CHOOSE ONE LETTER FROM EACH COLUMN": PRINT

712 NORMAL : HTAB 5: PRINT "INPUT FROM":; HTAB 25: PRINT "OUTPUT
    TO": PRINT
715 POKE 249,219: HTAB 5: CALL 250: PRINT "A3 KEYBOARD":; HTAB 25
    : CALL 250
716 PRINT "C3 KEYBOARD"
720 HTAB 5: CALL 250: PRINT "B3 FILE":; HTAB 25: CALL 250: PRINT
    "D3 FILE"
725 HTAB 25: CALL 250: PRINT "E3 BOTH FILE"
726 HTAB 29: PRINT "AND"
727 HTAB 29: PRINT "KEYBOARD"
729 VTAB 15
730 HTAB 6: GET A$: PRINT A$;:W1 = ASC (A$) - ASC ("A")
732 IF W1 = 1 OR W1 = 2 THEN GOTO 735
733 PRINT CHR$ (7): GOTO 729
735 VTAB 15: HTAB 26: GET B$: PRINT B$
736 W2 = ASC (B$) - ASC ("A")
737 IF W2 < 3 OR W2 > 5 THEN PRINT CHR$ (7): GOTO 735
740 IP = W1: REM INPUT SWITCH
742 OP = W2 - 2: REM OUTPUT SWITCH
745 PR = 2: REM PROCESS SWITCH - INDICATES DECIPHERMENT
750 IF IP = 2 OR OP = 2 OR OP = 3 THEN GOSUB 1600: REM OPEN FILE
    ES
755 PRINT : HTAB 5: FLASH : PRINT "TO STOP DECIPHERING, END"
756 HTAB 5: PRINT "INPUT LINE WITH A CONTROL-Z"
790 GOSUB 1500
799 RETURN
800 REM BUILD THE PLAYFAIR
801 REM SQUARE.
802 REM =====
805 HOME
808 FOR I = 1 TO 26:US(I) = - 1: NEXT I
810 INVERSE : VTAB 24: PRINT "ENTER CONTROL-Z TO RETURN IMMEDIATE
    LY":; NORMAL
815 VTAB 5: HTAB 5: PRINT "WHAT IS THE KEY?": HTAB 4: INPUT " :K
    Y$
816 IF LEFT$ (KY$,1) = CHR$ (26) THEN RETURN
817 K2$ = KY$: REM SAVE KEY FOR LATER DISPLAY
820 LG = LEN (KY$)
825 R = 0: C = 0
830 REM BUILD UP THE PLAYFAIR SQUARE
831 REM KEEP TRACK OF THE LETTERS
832 REM USED AS WE GO ALONG.
833 REM =====
834 IF LG = 0 THEN RETURN
835 FOR L = 1 TO LG
836 C$ = LEFT$ (KY$,1)
838 IF LEN (KY$) > 1 THEN KY$ = RIGHT$ (KY$, LEN (KY$) - 1)
840 X = ASC (C$) - ASC ("A") + 1
842 IF X < 1 OR X > 26 THEN 850
843 IF X = 10 THEN 850
845 Y = US(X)
846 IF Y = 0 THEN 850
848 GOSUB 870
850 NEXT L
855 REM NOW FILL IN THE LETTERS
856 REM WHICH DID NOT APPEAR
857 REM IN THE KEY. BE SURE
858 REM TO IGNORE "J".
859 REM =====
860 FOR X = 1 TO 26
861 IF X = 10 THEN 864
862 C$ = CHR$ (X + ASC ("A") - 1)
863 IF US(X) < 0 THEN GOSUB 870
864 NEXT X
865 GOSUB 890: REM INVERT THE SQUARE
866 REM DISPLAY THE SQUARE
867 REM =====
868 GOSUB 900
869 RETURN
870 REM "NEXTENTRY" SUBROUTINE
871 REM -----
872 L$ = "":R$ = ""
874 PF$(R,C) = C$
876 C = C + 1: IF C > 4 THEN C = 0:R = R + 1
878 US(X) = 0
880 RETURN
890 REM INVERT SUBROUTINE
891 REM -----
892 FOR I = 0 TO 4
893 FOR J = 0 TO 4
894 X = ASC (PF$(I,J)) - ASC ("A") + 1
895 ROW(X) = I
896 COL(X) = J
897 NEXT J
898 NEXT I
899 RETURN
900 REM DISPLAY THE NEWLY CREATED
901 REM PLAYFAIR SQUARE.
902 REM =====
905 HOME : VTAB 5: HTAB 5: INVERSE : PRINT "KEY ": NORMAL
906 PRINT K2$

```

**500—MAIN.** The main menu of the Playfair program. This subroutine first invokes INITs to perform "re"-initializations. It then presents the user with the menu of the program's top-level options. One of these at a time is chosen and carried out by calling lower levels of the program, until the user chooses to exit (option [I]). Note that the program refuses to encipher or decipher if the user has not yet set up a Playfair square.

**600—ENCIPHER SETUP.** Sets up the I/O options when the user chooses to encipher.

**700—DECIPHER SETUP.** Sets up the I/O options when the user chooses to decipher.

**800—BUILD PLAYFAIR.** Constructs the Playfair square, given the user key. If the user accidentally reaches this subroutine, he can exit with "no change" to the square by entering control-Z or simply return.

The routine fills the unique letters of the key into the Playfair square, which is array PF\$. It keeps track of the letters which have been used via an array—US. The entries, US(I), are initially set to -1. When a letter gets used by appearing in the key, its corresponding entry in US is set to 0. This prevents letters from being used twice. After the key is processed, a separate pass through US is made. As -1s are found in US, the program fills the letters corresponding to those entries into the remaining slots in the

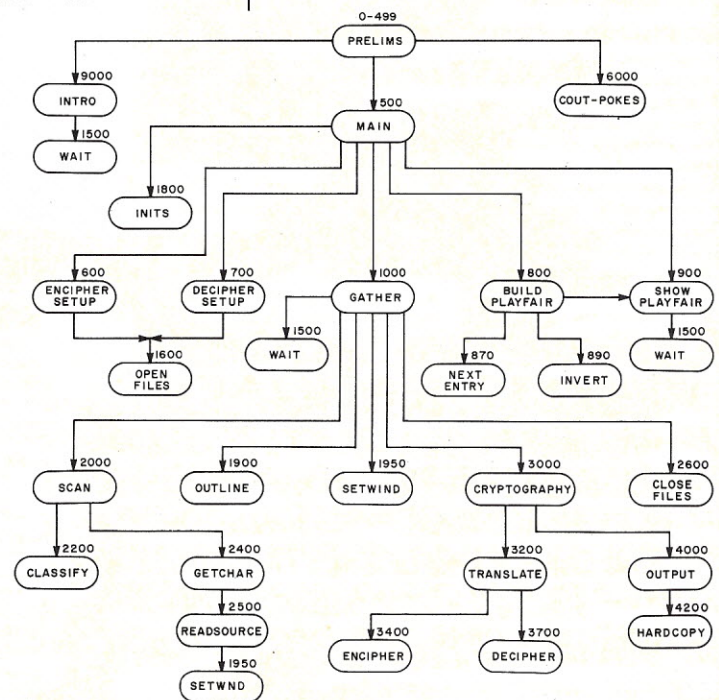


Fig. 4. Playfair program's routine-calling hierarchy.



Listing 1 continued.

```

910 VTAB 8: HTAB 5: INVERSE
911 PRINT "*****"
912 VTAB 16: HTAB 5: PRINT "*****"
915 VTAB 9
916 FOR I = 0 TO 6
917 HTAB 5: INVERSE : PRINT "*" ; NORMAL : PRINT " "
918 NEXT I
919 NORMAL
920 VTAB 10
925 FOR I = 0 TO 4
927 HTAB 7
930 FOR J = 0 TO 4
935 PRINT PF$(I,J) ; " "
940 NEXT J
945 PRINT
950 NEXT I
955 VTAB 18: HTAB 5: PRINT "PLAYFAIR SQUARE"
990 GOSUB 1500
999 RETURN
1000 REM DATA GATHERING DRIVER
1001 REM RESPONSIBLE FOR BOTH
1002 REM ENCIPHERING AND
1003 REM DECIPHERING AS WELL.
1004 REM =====
1005 GOSUB 1900: REM OUTLINE WINDOWS
1007 REM INITIALIZE PRINTER BUFFER
1008 B$ = ""
1010 GOSUB 2000: REM SCAN FOR FIRST CHARACTER
1015 P1$ = CH$
1020 GOSUB 2000: REM SCAN FOR SECOND CHARACTER
1025 P2$ = CH$
1030 IF P1$ = CHR$(26) THEN 1090
1035 IF P2$ = CHR$(26) THEN P2$ = "X": GOSUB 3000: GOTO 1090
1036 REM ENSURE DISTINCT LETTERS
1037 REM IN THE DIGRAPH
1038 IF P1$ = P2$ THEN TP$ = P2$: P2$ = "X": GOSUB 3000: P1$ = TP$:
GOTO 1020
1040 IF P1$ = "J" THEN P1$ = "I"
1041 IF P2$ = "J" THEN P2$ = "I"
1045 GOSUB 3000
1049 GOTO 1010
1090 WX = 2: GOSUB 1950
1092 T1 = FN M6(OI): T2 = INT (OI / 6): VTAB 12 + T2: HTAB 1 + 6 *
T1
1094 PRINT O$ ; " " ; SR$ = ""
1095 LA = 1: B$ = B$ + O$: GOSUB 4200: LA = 0
1096 GOSUB 2600: REM CLOSE FILES
1098 GOSUB 1500
1099 RETURN
1500 REM STANDARD WAIT ROUTINE
1501 REM =====
1505 VTAB 24: FLASH : HTAB 5
1510 PRINT "PRESS ANY KEY TO CONTINUE";
1525 POKE - 16368,0
1530 IF PEEK ( - 16384) < 128 THEN 1530
1535 POKE - 16368,0
1540 NORMAL
1549 RETURN
1600 REM OPEN FILES
1601 REM =====
1605 IF IP < > 2 THEN 1650
1610 HOME : VTAB 10: HTAB 5: INPUT "INPUT FILE? "; FI$
1615 CD$ = "OPEN " + FI$: GOSUB 1700: REM DOS CMD TO OPEN INPUT F
ILE
1650 IF OP < > 2 AND OP < > 3 THEN 1699
1655 HOME : VTAB 10: HTAB 5: INPUT "OUTPUT FILE? "; FO$
1660 CD$ = "OPEN " + FO$: GOSUB 1700: REM DOS CMD TO OPEN OUTPUT
FILE
1699 RETURN
1700 REM ISSUE DOS COMMANDS
1701 REM =====
1705 PRINT CHR$(4); CD$
1749 RETURN
1800 REM INITIALIZE IMPORTANT
1801 REM VARIABLES.
1802 REM =====
1805 SR$ = "": REM SOURCE LINE-FORCES FIRST GETSOURCE
1810 CH$ = "": REM CURRENT INPUT CHARACTER SET TO SPACE - FORCES
CALL TO GETCHAR
1815 OI = 0: REM OUTPUT INDEX - I.E.
1816 REM THE POSITION OF THE CURRENT
1817 REM OUTPUT GROUP ON THE
1818 REM OUTPUT LINE.
1819 REM =====
1820 O$ = "": REM OUTPUT GROUP - WILL
1821 REM TO FIVE LETTERS LONG.
1822 REM =====
1825 P1$ = "": P2$ = "": CH$ = " "
1830 B$ = "": REM OUTPUT BUFFER
1831 LA = 0: REM PRINTER CONTROL SWITCH
1835 WR(1) = 2: WC(1) = 2: REM INITIAL CURSOR FOR INPUT
1836 WR(2) = 12: WC(1) = 1: REM INITIAL CURSOR FOR OUTPUT
1840 REM SET WINDOW TO FULL SCREEN
1841 REM =====
1845 POKE 32,0: POKE 33,40: POKE 34,0: POKE 35,24
1899 RETURN
1900 REM DRAW WINDOWS TO
1901 REM SURROUND THE INPUT
1902 REM AND OUTPUT SCREENS
1903 REM =====
1905 HOME
1906 POKE 35,10
1908 VTAB 24: HTAB 1
1910 INVERSE : PRINT "*****";

```

More

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Listing 1 continued.

```

1917 POKE 35,24
1918 VTAB 11: HTAB 1
1920 PRINT "*****";
1925 VTAB 1: HTAB 1: PRINT "*****"
    ***;
1926 POKE 34,2
1928 NORMAL : POKE 34,1: POKE 35,24
1930 VTAB 2: HTAB 1
1932 FOR I = 2 TO 10
1934 INVERSE : PRINT "*" ; NORMAL : PRINT "
    " ; INVERSE : PRINT "*" ;

1935 NEXT I
1936 VTAB 12: HTAB 1
1937 FOR I = 12 TO 23
1938 INVERSE : PRINT "*" ; NORMAL
1939 PRINT "                                " ; INVERSE : PRINT
    "*" ;
1940 NEXT I
1948 NORMAL
1949 RETURN
1950 REM SUBROUTINE TO SET
1951 REM SCROLLING WINDOWS
1952 REM =====
1955 ON WX GOTO 1970,1980
1970 REM INPUT WINDOW
1971 REM =====
1975 POKE 32,1: POKE 33,38: POKE 34,1: POKE 35,10
1979 RETURN
1980 REM OUTPUT WINDOW
1981 REM =====
1985 POKE 32,1: POKE 33,38: POKE 34,11: POKE 35,23
1999 RETURN
2000 REM SCANNER SUBROUTINE
2001 REM RETURNS CHARACTERS
2002 REM FROM THE SOURCE TEXT.
2003 REM =====
2005 GOSUB 2400: REM GET A CHARACTER
2010 GOSUB 2200: REM CLASSIFY IT
2015 IF CC < > 1 THEN 2005: REM SKIP ALL BUT LETTERS AND CONTRO
    L-Z
2016 REM GATHERING ROUTINE CHECKS FOR tZ
2049 RETURN
2200 REM CLASSIFY CHARACTER
2201 REM =====
2205 IF CH$ = CHR$(26) THEN CC = 1: RETURN
2206 IF CH$ = CHR$(13) THEN CC = 0: RETURN
2210 A = ASC (CH$)
2215 IF A < ASC ("A") OR A > ASC ("Z") THEN CC = 0: RETURN
2220 CC = 1
2249 RETURN
2400 REM GET THE NEXT CHARACTER
2401 REM FROM THE SOURCE TEXT
2402 REM WE DON'T CARE WHETHER
2403 REM IT'S THE PLAIN OR THE
2404 REM CIPHER TEXT - WE JUST
2405 REM GET IT!!
2406 REM =====
2410 IF SR$ = "" THEN GOSUB 2500
2411 REM NEED MORE SOURCE
2415 LG = LEN (SR$): REM SEE HOW MUCH LEFT
2420 CH$ = LEFT$(SR$,1)
2425 IF LG > 1 THEN 2435
2430 IF SR$ < > CHR$(26) THEN SR$ = ""
2432 RETURN
2435 SR$ = RIGHT$(SR$, LEN (SR$) - 1)
2449 RETURN
2500 REM GET THE NEXT SOURCE LINE
2501 REM FROM THE CURRENTLY
2502 REM SELECTED SOURCE STREAM.
2503 REM =====
2505 WX = 1: REM INPUT WINDOW
2510 REM SET SCROLLING TO THE
2511 REM INPUT WINDOW
2515 GOSUB 1950
2520 IF IP = 1 THEN 2550: REM INPUT FROM THE KEYBOARD
2522 VTAB 2: HTAB 2
2524 PRINT D$
2525 PRINT D$;"READ ";FI$
2530 INPUT SR$
2531 PRINT D$
2532 PRINT D$
2549 RETURN
2550 REM READ THE NEXT LINE FROM THE KEYBOARD
2555 HOME : VTAB 2: HTAB 2
2560 PRINT "NEXT LINE OF TEXT..."
2565 INPUT SR$
2599 RETURN
2600 REM CHECK AND CLOSE FILES
2601 REM IF NECESSARY.
2602 REM =====
2604 PRINT D$: REM CANCEL ANY EXISTING DOS I/O COMMAND
2605 IF IP = 2 THEN PRINT D$;"CLOSE ";FI$
2610 IF OP = 2 OR OP = 3 THEN PRINT D$;"WRITE ";FO$: PRINT O$: CHR$
    (26): PRINT D$;"CLOSE ";FO$
2649 RETURN
2700 REM PRINTER MESSAGE
2701 REM =====
2705 NORMAL : VTAB 24: HTAB 5
2710 PRINT "PRINTER IS ";
2715 INVERSE
2720 IF HC = 0 THEN PRINT "OFF";
2722 IF HC = 1 THEN PRINT "ON";
2725 NORMAL
2749 RETURN
3000 REM CRYPTOGRAPHY
3001 REM ROUTINE.

```

More →

Playfair square.

**870—NEXT ENTRY.** Puts a letter into the appropriate row and column of the Playfair square and advances the row and column indicators.

**890—INVERT.** For each letter in the Playfair square, the row and column which it occupies are recorded in the arrays ROW and COL. This provides a quick means of locating any given letter in the square without having to search the square for it.

**900—SHOW PLAYFAIR.** Shows the current Playfair square, and its key, on the video display.

**1000—GATHER.** This routine is the boss of the translation process. It is responsible for gathering digraphs and invoking the translation process. Its most important task is to detect the end of the input by looking for a control-Z character in the incoming character stream. In addition, it makes sure that each digraph fed to the translating routines has distinct letters, and it translates any J to an I.

**1500—WAIT.** Causes a pause until the user strikes a key on the Apple's terminal keyboard. It is called by many of the other routines, when it is necessary to assimilate some message on the screen. It prompts the user by flashing the message "PRESS ANY KEY TO CONTINUE" on the bottom line of the display.

**1600—OPEN FILES.** Uses the input and output switches (IP and OP) to detect whether input or output files are desired.

**1800—INITS.** Performs initializations that are necessary before each repetition of the main menu prompts.

**1900—OUTLINE.** The screen is subdivided into two areas, one each for input and output. This routine outlines those areas with asterisks.

**1950—SETWND.** This routine sets the scrolling window of the display to either the input area or the output area, whichever is appropriate. The choice is determined by the value of WX, set by the caller.

**2000—SCAN.** This routine calls GETCHAR and CLASSIFY until the current character is either a letter or control-Z (indicated by CC=1).

**2200—CLASSIFY.** This routine examines the current character and sets the variable CC to 0 or 1, depending on the class of character. Letters and control-Z are in class 1; all other characters are in class 0.

**2400—GETCHAR.** Picks off the next input character. Input is held in the string variable SR\$. If SR\$ should be exhausted (SR\$=""), then GET-



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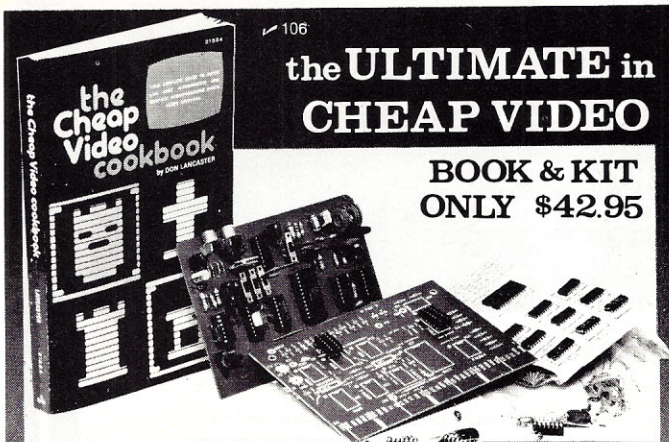
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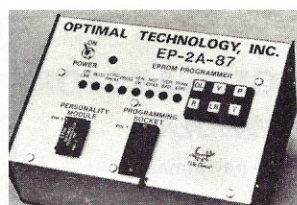
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Listing 1 continued.

```

3002 REM BOTH ENCIPHERING
3003 REM AND DECIPHERING
3004 REM HANDLED.
3005 REM =====
3010 GOSUB 3200: REM TRANSLATE TO NEW DIGRAPH
3015 O$ = O$ + C1$: REM STUFF FIRST LETTER TO OUTPUT QUEUE
3020 GOSUB 4000: REM CHECK ON OUTPUT
3025 O$ = O$ + C2$
3030 GOSUB 4000
3049 RETURN
3099 RETURN
3200 REM TRANSLATE DIGRAPH
3201 REM BY VECTORING TO
3202 REM APPROPRIATE CIPHER
3203 REM ROUTINE BASED ON
3204 REM THE PROCESS SWITCH.
3205 REM =====
3210 IF PR = 1 THEN GOSUB 3400: REM ENCIPHER
3215 IF PR = 2 THEN GOSUB 3700: REM DECIPHER
3249 RETURN
3400 REM ENCIPHER THE CURRENT
3401 REM DIGRAPH. NOTE:
3402 REM THE GATHERING ROUTINE
3403 REM GUARANTEES THAT P1$ <> P2$
3404 REM =====
3405 P1 = ASC (P1$) - ASC ("A") + 1
3410 P2 = ASC (P2$) - ASC ("A") + 1
3415 IF ROW(P1) < > ROW(P2) THEN 3425
3420 GOSUB 3500: RETURN
3425 IF COL(P1) < > COL(P2) THEN 3450
3430 GOSUB 3600: RETURN
3450 REM DIFFERENT ROW AND COLUMN
3451 REM =====
3455 R1 = ROW(P1):R2 = ROW(P2)
3460 S1 = COL(P1):S2 = COL(P2)
3465 C1$ = PF$(R1,S2)
3470 C2$ = PF$(R2,S1)
3499 RETURN
3500 REM SAME ROW
3501 REM =====
3505 R1 = ROW(P1):R2 = ROW(P2)
3510 S1 = COL(P1) + 1: IF S1 = 5 THEN S1 = 0
3515 S2 = COL(P2) + 1: IF S2 = 5 THEN S2 = 0
3520 C1$ = PF$(R1,S1)
3525 C2$ = PF$(R2,S2)
3549 RETURN
3600 REM SAME COLUMN
3601 REM =====
3605 S1 = COL(P1):S2 = COL(P2)
3610 R1 = ROW(P1) + 1: IF R1 = 5 THEN R1 = 0
3615 R2 = ROW(P2) + 1: IF R2 = 5 THEN R2 = 0
3620 C1$ = PF$(R1,S1)
3625 C2$ = PF$(R2,S2)
3649 RETURN
3700 REM DECIPHER THE CURRENT
3701 REM DIGRAPH
3702 REM =====
3705 P1 = ASC (P1$) - ASC ("A") + 1
3710 P2 = ASC (P2$) - ASC ("A") + 1
3715 IF ROW(P1) < > ROW(P2) THEN 3725
3720 GOSUB 3800: RETURN
3725 IF COL(P1) < > COL(P2) THEN 3750
3730 GOSUB 3900: RETURN
3750 REM DIFFERENT ROW AND COLUMN
3755 R1 = ROW(P1):R2 = ROW(P2)
3760 S1 = COL(P1):S2 = COL(P2)
3765 C1$ = PF$(R1,S2)
3770 C2$ = PF$(R2,S1)
3799 RETURN
3800 REM SAME ROW
3801 REM =====
3805 R1 = ROW(P1):R2 = ROW(P2)
3810 S1 = COL(P1) - 1: IF S1 = - 1 THEN S1 = 4
3815 S2 = COL(P2) - 1: IF S2 = - 1 THEN S2 = 4
3820 C1$ = PF$(R1,S1)
3825 C2$ = PF$(R2,S2)
3849 RETURN
3900 REM SAME COLUMN
3901 REM =====
3905 S1 = COL(P1):S2 = COL(P2)
3910 R1 = ROW(P1) - 1: IF R1 = - 1 THEN R1 = 4
3915 R2 = ROW(P2) - 1: IF R2 = - 1 THEN R2 = 4
3920 C1$ = PF$(R1,S1)
3925 C2$ = PF$(R2,S2)
3949 RETURN
4000 REM OUTPUT SUBROUTINE
4001 REM =====
4005 IF LEN (O$) < > 5 THEN RETURN
4006 REM NOW SETUP OUTPUT WINDOW
4007 WX = 2: GOSUB 1950
4010 T$ = O$:O$ = " ": REM START A NEW GROUP
4012 B$ = B$ + T$ + " ": IF HC = 1 THEN GOSUB 4200
4013 IF HC = 0 THEN B$ = " "
4015 IF OP = 2 THEN 4050
4016 T1 = FN M6(OI):T2 = INT (OI / 6)
4018 VTAB 12 + T2: HTAB 1 + 6 * T1
4020 PRINT T$;" "
4025 OI = OI + 1
4026 IF OI = 72 THEN CALL - 912:OI = 66
4030 IF OP < > 3 THEN RETURN
4050 REM DISK OUTPUT
4051 REM =====
4054 PRINT D$
4055 PRINT D$;"WRITE "%F0$
4060 PRINT T$;" "

```

More



CHAR invokes READSOURCE to get more.

**2500—READSOURCE.** Reads the next line of input from the active input stream—either the keyboard or the file selected by the user. It is important to note that if the program is fed a text file created by some means other than running the program itself, the END OF DATA message will result if the file does not end with control-Z.

**2600—CLOSE FILES.** Called at the end of a given encipher or decipher to close any open files.

**3000—CRYPTOGRAPHY.** Invokes the translation process and makes sure the results get output.

**3200—TRANSLATE.** Uses the process switch (PR) to invoke the appropriate translation routine.

**3400—ENCIPHER.** Actually carries out the encipherment of each digraph. The letters of the plain-text digraph are stored in the string variables P1\$ and P2\$. The resulting cipher-text letters are stored in the string variables C1\$ and C2\$.

**3700—DECIPHER.** Carries out the decipherment of each digraph. Since the scanning routines are unaware of which translation process is going on, the incoming digraph (cipher text) is still stored in the variables P1\$, P2\$, and the outgoing digraph (plain text) will be stored in the variables C1\$, C2\$.

**4000—OUTPUT.** This routine supervises the output. It waits until a group of five letters has been prepared, by examining the length of the string in O\$. It makes sure that the output goes to just the right places, by using the switches OP and HC.

**4200—HARDCOPY.** Dumps output to the printer when appropriate. It waits until a buffer, B\$, reaches length 72 before printing. This might have to be modified for some printers.

**6000—COUT-POKES.** Strictly speaking, this routine is not necessary. It pokes in a machine-language routine which enables the user to output any character desired by first poking its code into location 249. It is used by the MAIN routine and the ENCIPHER SETUP and DECIPHER SETUP routines in order to print the "[" character. This could also have been done by using the CHR\$ function. A routine such as this would be necessary in Integer BASIC.

**9000—INTRO.** Prints a brief general introduction to the program. ■

*Listing 1 continued.*

```
4070 PRINT D$; PRINT D$
4099 RETURN
4200 REM HARD COPY OUTPUT ROUTINE
4201 REM INVOKED WHEN THE HC FLAG
4202 REM IS TRUE (=1).
4203 REM
4205 IF HC = 0 THEN RETURN
4207 IF LA = 1 THEN 4210
4208 IF LEN (B$) < 72 THEN RETURN
4210 PRINT D$
4215 PRINT D$;"PR#1"
4217 PRINT CHR$ (9);"72N";
4220 PRINT B$;
4225 PRINT D$
4230 PRINT D$;"PR#0"
4235 B$ = ""
4249 RETURN
6000 REM POKE IN COUT
6001 REM INTERFACE ROUTINE
6002 REM =====
6005 POKE 250,165; POKE 251,249
6006 POKE 252,32; POKE 253,237; POKE 254,253
6007 POKE 255,96
6010 RETURN
6015 REM TO USE:
6016 REM
6017 REM POKE 249,CODE
6018 REM CALL 250
6109 REM
6120 REM WHERE,
6121 REM
6122 REM CODE=APPLE CHARACTER
6123 REM CODE DESIRED
6124 REM -----
9000 REM INTRODUCTION
9001 REM
9005 HOME
9010 PRINT " THIS PROGRAM WILL DEMONSTRATE THE"
9011 PRINT "FAMOUS PLAYFAIR CIPHER. THIS IS THE"
9012 PRINT "METHOD OF ENCRYPTION USED TO SEND THE"
9013 PRINT "DISTRESS SIGNAL FROM THE SINKING PT109"
9014 PRINT "BOAT COMMANDED BY JOHN F. KENNEDY IN "
9015 PRINT "WORLD WAR II. THE PROGRAM WILL ALLOW
9016 PRINT "YOU TO CONSTRUCT PLAYFAIR SQUARES,"
9017 PRINT "AND USE THE RESULTING SQUARES TO BOTH"
9018 PRINT "ENCODE AND DECODE SECRET MESSAGES."
9019 PRINT : PRINT " THIS VERSION OF THE PROGRAM WILL"
9020 PRINT "ASSUME THAT YOU ARE ALREADY FAMILIAR"
9021 PRINT "WITH THE THEORY OF OPERATION OF THE"
9022 PRINT "CIPHER."
9090 GOSUB 1500
9099 RETURN
```

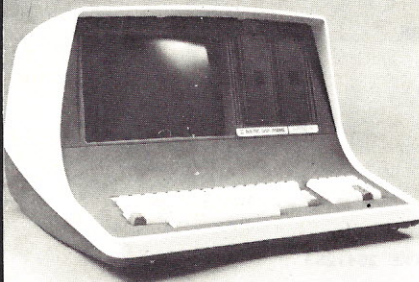
*Listing 2.*

```
100 HOME
101 INVERSE : VTAB 5
102 PRINT "FOR INFORMATION ON ONE OF THE FOLLOWING ";
105 PRINT "ROUTINES, TYPE THE CORRESPONDING LETTER:"
109 NORMAL
110 PRINT CHR$ (219);"A] MAIN"
111 PRINT CHR$ (219);"B] ENCIPHER SETUP"
112 PRINT CHR$ (219);"C] DECIPHER SETUP"
113 PRINT CHR$ (219);"D] BUILD PLAYFAIR"
114 PRINT CHR$ (219);"E] NEXT ENTRY"
115 PRINT CHR$ (219);"F] INVERT"
116 PRINT CHR$ (219);"G] SHOW PLAYFAIR"
117 PRINT CHR$ (219);"H] GATHER"
118 PRINT CHR$ (219);"I] WAIT"
119 PRINT CHR$ (219);"J] OPEN FILES"
120 PRINT CHR$ (219);"K] INITS"
121 PRINT CHR$ (219);"L] OUTLINE"
122 PRINT CHR$ (219);"M] SETWND"
125 VTAB 8
126 HTAB 22: PRINT CHR$ (219);"N] SCAN"
127 HTAB 22: PRINT CHR$ (219);"O] CLASSIFY"
128 HTAB 22: PRINT CHR$ (219);"P] GETCHAR"
129 HTAB 22: PRINT CHR$ (219);"Q] READSOURCE"
130 HTAB 22: PRINT CHR$ (219);"R] CLOSE FILES"
131 HTAB 22: PRINT CHR$ (219);"S] CRYPTOGRAPHY"
132 HTAB 22: PRINT CHR$ (219);"T] TRANSLATE"
133 HTAB 22: PRINT CHR$ (219);"U] ENCIPHER"
134 HTAB 22: PRINT CHR$ (219);"V] DECIPHER"
135 HTAB 22: PRINT CHR$ (219);"W] OUTPUT"
136 HTAB 22: PRINT CHR$ (219);"X] HARDCOPY"
137 HTAB 22: PRINT CHR$ (219);"Y] COUT POKES"
138 HTAB 22: PRINT CHR$ (219);"Z] INTRO"
150 VTAB 24: HTAB 8
151 FLASH : PRINT "TO QUIT - HIT RETURN";
152 NORMAL
500 VTAB 22: HTAB 5
505 GET A$:WH = ASC (A$) - ASC ("0")
510 IF WH < > - 61 AND WH < > - 51 THEN 519
514 HOME
515 PRINT CHR$ (4): PRINT CHR$ (4);"RUN PLAYFAIR CIPHER"
519 IF WH < 0 THEN 525
520 ON WH GOTO 1000,1100,1200,1300,1400,1500,1600,1700,1800,1900,
2000,2100,2200,2300,2400,2500,2600,2700,2800,2900,3000,3100,3
```

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Listing 2 continued.

```

200,3300,3400,3500
525  VTAB 22: HTAB 10: FLASH : PRINT "TRY AGAIN": NORMAL : GOTO 50
0
1000 REM MAIN
1001 REM =====
1005 R$ = "MAIN":LI = 500: GOSUB 5000
1010 VTAB 5
1011 PRINT " THIS IS THE MAIN MENU ROUTINE."
1012 PRINT "IT CALLS"; INVERSE : PRINT " INITs "; NORMAL : PRINT
"AND PRESENTS THE OPTIONS"
1013 PRINT "AVAILABLE TO THE USER. THE USER SELECTS";
1014 PRINT "AN OPTION BY TYPING A LETTER. THE"
1015 PRINT "ROUTINE CALLS LOWER LEVEL ROUTINES TO"
1016 PRINT "CARRY OUT THE FUNCTION INDICATED AND"
1017 PRINT "THEN REPEATS THE MENU."
1098 GOSUB 6000
1099 GOTO 100
1100 REM ENCIPHER SETUP
1101 REM =====
1105 R$ = "ENCIPHER SETUP":LI = 600: GOSUB 5000
1110 VTAB 5
1111 PRINT " SETS UP THE I/O OPTIONS FOR"
1112 PRINT "ENCIPHERING. IT MAY CALL";
1113 INVERSE : PRINT " OPEN FILES "; NORMAL : PRINT " IF INDICATE
D."
1198 GOSUB 6000
1199 GOTO 100
1200 REM DECIPHER SETUP
1201 REM =====
1205 R$ = "DECIPHER SETUP":LI = 700: GOSUB 5000
1210 VTAB 5
1211 PRINT " SETS UP THE I/O OPTIONS FOR"
1212 PRINT "DECIPHERING. IT MAY CALL";
1213 INVERSE : PRINT " OPEN FILES "; NORMAL : PRINT " IF INDICATE
D."
1298 GOSUB 6000
1299 GOTO 100
1300 REM BUILD PLAYFAIR
1301 REM =====
1305 R$ = "BUILD PLAYFAIR":LI = 800: GOSUB 5000
1310 VTAB 5
1311 PRINT " BUILDS A NEW PLAYFAIR SQUARE AFTER"
1312 PRINT "PROMPTING THE USER FOR A KEY."
1313 PRINT "CALLS"; INVERSE : PRINT " NEXT ENTRY ";
1314 NORMAL : PRINT "AND"; INVERSE : PRINT " INVERT.": NORMAL
1398 GOSUB 6000
1399 GOTO 100
1400 REM NEXT ENTRY
1401 REM =====
1405 R$ = "NEXT ENTRY":LI = 870: GOSUB 5000
1410 VTAB 5
1411 PRINT " ENTERS A LETTER INTO THE PLAYFAIR"
1412 PRINT "SQUARE AND ADVANCES THE ROW AND COLUMN"
1413 PRINT "INDICATORS."
1498 GOSUB 6000
1499 GOTO 100
1500 REM INVERT
1501 REM =====
1505 R$ = "INVERT":LI = 890: GOSUB 5000
1510 VTAB 5
1511 PRINT " 'INVERTS' THE PLAYFAIR SQUARE BY "
1512 PRINT "STORING THE ROW AND COLUMN LOCATIONS"
1513 PRINT "OF EACH LETTER IN SEPARATE ARRAYS. THIS"
1514 PRINT "ALLOWS QUICK LOOKUP OF A GIVEN LETTER"
1515 PRINT "IN THE SQUARE."
1598 GOSUB 6000
1599 GOTO 100
1600 REM SHOW PLAYFAIR
1601 REM =====
1605 R$ = "SHOW PLAYFAIR":LI = 900: GOSUB 5000
1610 VTAB 5
1611 PRINT " DISPLAYS THE CURRENT PLAYFAIR SQUARE"
1612 PRINT "AND ITS KEY."
1698 GOSUB 6000
1699 GOTO 100
1700 REM GATHER
1701 REM =====
1705 R$ = "GATHER":LI = 1000: GOSUB 5000
1710 VTAB 5
1711 PRINT " THE 'BOSS' OF THE TRANSLATION PROCESS. ";
1712 PRINT "IT GATHERS DIGRAPHS AND FEEDS THEM TO "
1713 PRINT "LOWER LEVEL TRANSLATION ROUTINES."
1714 PRINT " IT GUARANTEES THE UNIQUENESS OF THE"
1715 PRINT "LETTERS IN EACH DIGRAPH AND DETECTS THE"
1716 PRINT "END OF THE INPUT. IT CALLS";
1717 INVERSE : PRINT " WAIT "; NORMAL
1718 PRINT ","; INVERSE : PRINT " SCAN "; NORMAL
1719 PRINT ","; INVERSE : PRINT " OUTLINE "; NORMAL
1720 PRINT ","; INVERSE : PRINT " SETWND "; NORMAL
1721 PRINT ","; INVERSE : PRINT " CRYPTOGRAPHY "; NORMAL
1722 PRINT " AND "; INVERSE : PRINT " CLOSE FILES. "; NORMAL
1798 GOSUB 6000
1799 GOTO 100
1800 REM WAIT
1801 REM =====
1805 R$ = "WAIT":LI = 1500: GOSUB 5000
1810 VTAB 5
1811 PRINT " PAUSES UNTIL THE USER STRIKES A KEY"
1812 PRINT "ON THE APPLE 3"; CHR$(219); " KEYBOARD."
1898 GOSUB 6000
1899 GOTO 100
1900 REM OPEN FILES
1901 REM =====
1905 R$ = "OPEN FILES":LI = 1600: GOSUB 5000
1910 VTAB 5

```

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Listing 2 continued.

```
1911 PRINT " OPENS EITHER A SINGLE INPUT FILE OR A"
1912 PRINT "SINGLE OUTPUT FILE, OR BOTH. IT USES"
1913 PRINT "THE VALUES OF THE SWITCHES IP AND OP"
1914 PRINT "FOR GUIDANCE. THESE ARE SET BY THE"
1915 PRINT "ROUTINES"; INVERSE : PRINT " ENCIPHER SETUP "; NORMAL
: PRINT "AND"
1916 INVERSE : PRINT " DECIPHER SETUP.": NORMAL
1998 GOSUB 6000
1999 GOTO 100
2000 REM INITS
2001 REM =====
2005 R$ = "INITS":LI = 1800: GOSUB 5000
2010 VTAB 5
2011 PRINT " PERFORMS RE-INITIALIZATION BEFORE "
2012 PRINT "EACH SELECTION OF A MENU OPTION. MOST"
2013 PRINT "IMPORTANT ARE VARIABLES DEALING WITH "
2014 PRINT "THE TRANSLATION PROCESS, SUCH AS SR$,"
2015 PRINT "THE INPUT TEXT LINE; AND SWITCHES FOR"
2016 PRINT "SUCH THINGS AS I/O. NOTE: THE PRINTER"
2017 PRINT "(HARDCOPY) SWITCH IS NOT RE-INITIALIZED"
2018 PRINT "EXCEPT BY THE USER."
2098 GOSUB 6000
2099 GOTO 100
2100 REM OUTLINE
2101 REM =====
2105 R$ = "OUTLINE":LI = 1900: GOSUB 5000
2110 VTAB 5
2111 PRINT " OUTLINES THE SCREEN WITH ASTERISKS,"
2112 PRINT "SUBDIVIDING IT INTO TWO 'WINDOWS', ONE"
2113 PRINT "FOR INPUT TEXT AND ONE FOR OUTPUT TEXT."
2198 GOSUB 6000
2199 GOTO 100
2200 REM SETWND
2201 REM =====
2205 R$ = "SETWND":LI = 1950: GOSUB 5000
2210 VTAB 5
2211 PRINT " SETS THE APPLE'S SCROLLING WINDOW TO"
2212 PRINT "EITHER THE INPUT OR THE OUTPUT PORTION"
2213 PRINT "OF THE SCREEN."
2298 GOSUB 6000
2299 GOTO 100
2300 REM SCAN
2301 REM =====
2305 R$ = "SCAN":LI = 2000: GOSUB 5000
2310 VTAB 5
2311 PRINT " REPEATEDLY CALLS"; INVERSE : PRINT " GETCHAR "; NORMAL
: PRINT "AND"
2312 INVERSE : PRINT "CLASSIFY "; NORMAL : PRINT "UNTIL THE CURR
ENT CHARACTER"
2313 PRINT "IS EITHER CONTROL-Z OR A LETTER. THIS "
2314 PRINT "IS INDICATED BY THE VALUE OF THE"
2315 PRINT "VARIABLE CC. IF CC=1, THEN SCAN HAS DONE";
2316 PRINT "ITS JOB."
2398 GOSUB 6000
2399 GOTO 100
2400 REM CLASSIFY
2401 REM =====
2405 R$ = "CLASSIFY":LI = 2200: GOSUB 5000
2410 VTAB 5
2411 PRINT " SETS THE VARIABLE CC (ABBREVIATION"
2412 PRINT "FOR 'CHARACTER CLASS') TO EITHER 0 OR 1"
2413 PRINT "DEPENDING ON THE CLASS OF THAT CHARACTER";
2414 PRINT "LETTERS AND CONTROL-Z ARE IN CLASS 1."
2415 PRINT "ALL OTHER CHARACTERS ARE IN CLASS 0."
2498 GOSUB 6000
2499 GOTO 100
2500 REM GETCHAR
2501 REM =====
2505 R$ = "GETCHAR":LI = 2400: GOSUB 5000
2510 VTAB 5
2511 PRINT " GETS THE NEXT CHARACTER FROM SR$, THE"
2512 PRINT "INPUT LINE, IF THERE IS ONE. IF NOT"
2513 PRINT "(SR$=''), IT CALLS"; INVERSE : PRINT " READSOURCE ";
: NORMAL : PRINT " TO"
2514 PRINT "RETURN THE NEXT LINE OF TEXT."
2598 GOSUB 6000
2599 GOTO 100
2600 REM READSOURCE
2601 REM =====
2605 R$ = "READSOURCE":LI = 2500: GOSUB 5000
2610 VTAB 5
2611 PRINT " READS THE NEXT LINE OF TEXT FROM THE"
2612 PRINT "CURRENTLY ACTIVE INPUT MEDIUM - EITHER"
2613 PRINT "KEYBOARD OR FILE. IT USES THE IP SWITCH";
2614 PRINT "TO GUIDE ITSELF."
2698 GOSUB 6000
2699 GOTO 100
2700 REM CLOSE FILES
2701 REM =====
2705 R$ = "CLOSE FILES":LI = 2600: GOSUB 5000
2710 VTAB 5
2711 PRINT " CLOSES ANY OPEN FILES AT THE END OF"
2712 PRINT "EACH INDIVIDUAL TRANSLATION SESSION."
2713 PRINT "THUS, IT MAY BE INVOKED MANY TIMES "
2714 PRINT "DURING THE SAME PROGRAM RUN."
2798 GOSUB 6000
2799 GOTO 100
2800 REM CRYPTOGRAPHY
2801 REM =====
2805 R$ = "CRYPTOGRAPHY":LI = 3000: GOSUB 5000
2810 VTAB 5
2811 PRINT " INVOKES THE TRANSLATION PROCESS AND"
2812 PRINT "MAKES SURE THE RESULTS ARE OUTPUT."
2898 GOSUB 6000
2899 GOTO 100
```

More



Listing 2 continued.

```

2900 REM TRANSLATE
2901 REM =====
2905 R$ = "TRANSLATE":LI = 3200: GOSUB 5000
2910 VTAB 5
2911 PRINT "USES THE PROCESS SWITCH (PR) TO DETECT";
2912 PRINT "WHICH TRANSLATION ROUTINE TO INVOKE."
2913 PRINT "CALLS BOTH"; INVERSE : PRINT "ENCIPHER"; NORMAL :
PRINT "AND"; INVERSE : PRINT "DECIPHER"; NORMAL
2998 GOSUB 6000
2999 GOTO 100
3000 REM ENCIPHER
3001 REM =====
3005 R$ = "ENCIPHER":LI = 3400: GOSUB 5000
3010 VTAB 5
3011 PRINT "CARRIES OUT THE DETAILS OF CONVERTING"
3012 PRINT "PLAIN TEXT PAIRS TO CIPHER TEXT PAIRS."
3098 GOSUB 6000
3099 GOTO 100
3100 REM DECIPHER
3101 REM =====
3105 R$ = "DECIPHER":LI = 3700: GOSUB 5000
3110 VTAB 5
3111 PRINT "CARRIES OUT THE DETAILS OF CONVERTING"
3112 PRINT "CIPHER TEXT PAIRS TO PLAIN TEXT PAIRS."
3198 GOSUB 6000
3199 GOTO 100
3200 REM OUTPUT
3201 REM =====
3205 R$ = "OUTPUT":LI = 4000: GOSUB 5000
3210 VTAB 5
3211 PRINT "SUPERVISES OUTPUT TO THE VARIOUS"
3212 PRINT "DEVICES. IT WAITS UNTIL 5 LETTERS HAVE"
3213 PRINT "BEEN ACCUMULATED. THIS IS TO ENSURE "
3214 PRINT "THE 'STANDARD' CRYPTOGRAPHIC OUTPUT"
3215 PRINT "FORMAT."
3216 PRINT "CALLS"; INVERSE : PRINT "HARDCOPY"; NORMAL
3298 GOSUB 6000
3299 GOTO 100
3300 REM HARDCOPY
3301 REM =====
3305 R$ = "HARDCOPY":LI = 4200: GOSUB 5000
3310 VTAB 5
3311 PRINT "PRODUCES THE PRINTER OUTPUT. IT WAITS";
3312 PRINT "UNTIL A BUFFER (B$) FILLS WITH 72 "
3313 PRINT "CHARACTERS BEFORE SENDING IT TO THE"
3314 PRINT "PRINTER."
3398 GOSUB 6000
3399 GOTO 100
3400 REM COUT POKES
3401 REM =====
3405 R$ = "COUT POKES":LI = 6000: GOSUB 5000
3410 VTAB 5
3411 PRINT "POKES IN AN INTERFACE ROUTINE TO THE"
3412 PRINT "MONITOR COUT SUBROUTINE."
3498 GOSUB 6000
3499 GOTO 100
3500 REM INTRO
3501 REM =====
3505 R$ = "INTRO":LI = 9000: GOSUB 5000
3510 VTAB 5
3511 PRINT "INTRODUCES THE PROGRAM."
3598 GOSUB 6000
3599 GOTO 100
5000 REM SETUP
5001 REM =====
5005 HOME : INVERSE
5010 VTAB 2: PRINT "ROUTINE NAME:"
5015 PRINT "STARTS AT: "
5020 NORMAL
5025 VTAB 2: HTAB 19: PRINT R$
5030 HTAB 19: PRINT LI
5049 RETURN
6000 REM STANDARD WAIT ROUTINE
6001 REM =====
6005 VTAB 24: FLASH : HTAB 5
6010 PRINT "PRESS ANY KEY TO CONTINUE";
6015 POKE - 16384,0
6020 IF PEEK ( - 16384 ) < 128 THEN 6020
6025 POKE - 16384,0
6030 NORMAL
6049 RETURN

```

### Challenge Cipher

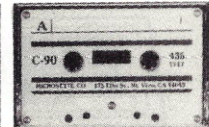
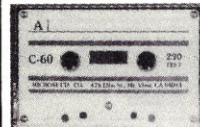
For those readers who enjoy cryptanalysis, I present in closing the following cipher text, created using the Playfair program. If you give up, turn to page 192 to find the key.

RAPYN AEPGT THOQC GOKXS BOXSP TMAOC OQCGG  
DYCPM MGOYI NAUAI LDGDA EGVGM DOAQI KAUGV  
DLTCB QMAMP BASID RTUDO RNWOB ASITE FOKBD  
OFIMG ELOQC PCTLR GTUTF AGMIP IYKDL TSILC  
DCMAV ANISI DGDRS IXSDR GRLRL CFODC ABQUC  
GUAGV AMKGB TPSSI GMIPQ IKHYA CDAMB TSYXX

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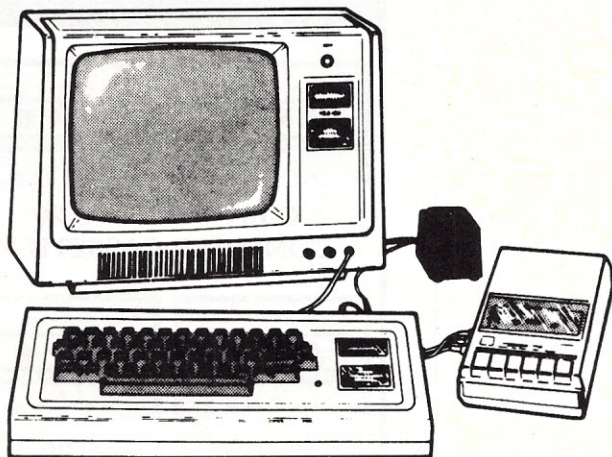
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can even fetch, decode, disassemble and analyze each instruction individually so that your program cannot bomb out.

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# Energize Those OSI Peripheral Ports

By Edward C. Jones

If you own an OSI Challenger 1P or Superboard II, you might wonder about those Molex connectors on the circuit board and whether you can hook up a printer or modem to them. You might have actually tried to hook up a printer to the connectors, only to discover that it will not work. Take heart: you can have those ports working in about two hours and with \$10 to \$20 in parts. Use the plastic Molex connectors, J2 and J3, on the circuit board to provide these signals. The

mod will activate both ports, and provide switch-selectable user control of incoming data.

## Preparation

Standard CIP/Superboards have the holes already drilled to accept components, but do not come equipped with them. See the parts list for the required hardware.

For C1P owners (Superboard owners can skip this paragraph), the first step is to remove the circuit board. Disconnect the cassette cables, the video cable and the power cord. Turn the computer over and remove the

six screws. Remove the cover. Remove the six screws that hold the circuit board to the case. Take the board out of the case and put it on your work surface.

## Modifications

Look at Fig. 1. First, install the additional components. Position your circuit board so that the keyboard is facing away from you. Looking at the rear of the board, locate the J2 connector, which is the connector that your cassette recorder plugs into. Just to the left of the connector are a lot of empty holes. This is the area that you'll be working in.

First, locate the correct area shown for the 12 resistors in two rows, R38 through R49 on the OSI schematic. Obtain all of the 220 ohm and 390 ohm resistors, and bend one of the leads as shown. Insert one each of the 220 ohm resistors into the two holes at locations R38, R40, R42, R44, R46 and R48.

Next, insert one each of the 390 ohm resistors into the two holes at locations R39, R41, R43, R45, R47 and R49.

Now insert the two 14-pin sockets into the holes at locations U67 and U68, just above the new resistors. It does not matter which way you install the sockets.

Now lightly tape the resistors and sockets to the circuit board. Then turn the board upside down and sol-

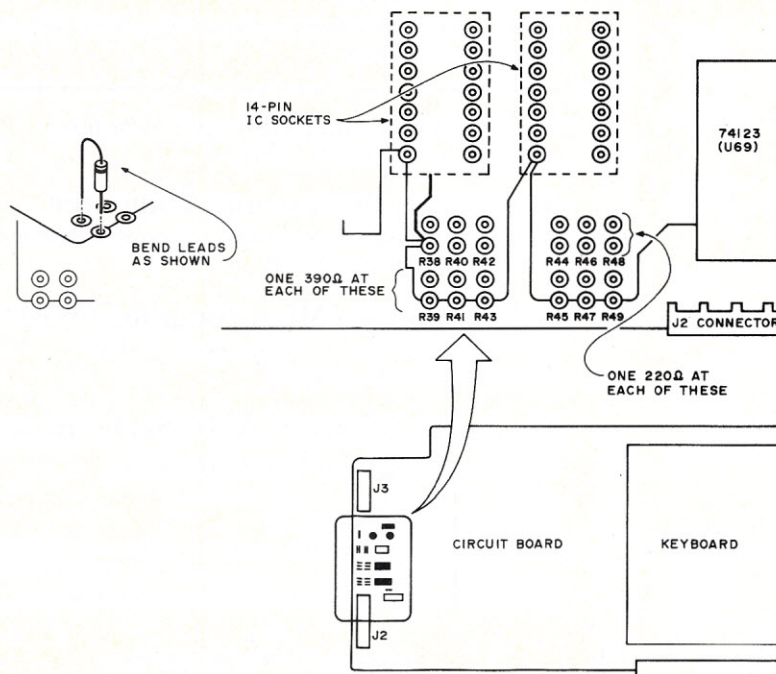


Fig. 1.

Edward C. Jones, 2334 Antiqua Court, Reston, VA 22091.



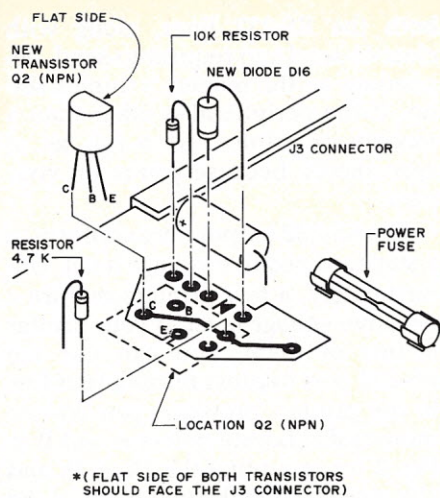


Fig. 2.

der the new components to the connection points. Cut the excess leads from the resistors, turn the board back over and remove the tape.

Look at Fig. 2 and locate the holes for the transistors at locations Q1 and Q2, and for the diode at location D16. Note the layout of the transistor leads and the diode leads. (Be careful not to mix up the npn and the pnp transistors.) Looking at the circuit board from the rear, orient the transistors as shown, and insert the pnp transistor into the Q1 location, and the npn transistor into the Q2 location. Insert the diode into the two holes at location D16. The end with the band should be facing the rear of the circuit board.

You should have six resistors remaining—470 ohm, 1k, 4.7k and three 10k. Bend the leads in the same

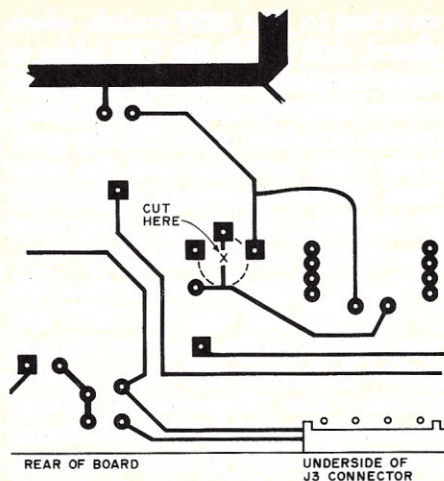


Fig. 3.

manner as the other resistors and insert them in the holes as shown in the figure. Check that the transistors and diode are inserted correctly. Cut two strips of aluminum foil, approximately 1/4 by 3 or 4 inches. Twist and wrap the strips around the transistor leads as shown. Lightly tape the transistors, resistors and the diode to the board; then turn the board upside down and solder the leads to the connections. Cut the excess leads. Leave the board upside down.

Next come the switch wiring and mounting. Locate the area shown in Fig. 3. You'll need to cut the wire shown connecting these two points. Carefully use a small knife or file, and cut the wire run shown on the circuit board.

Now turn the board right side up, remove the aluminum foil from the transistors, and locate the wiring area just to left of the #1 key on the keyboard. Cut the wire run as shown in Fig. 4. Connect two wires, about 12 inches in length, to the two terminals of the SPST switch. Solder the other ends of the two wires to the connection holes on the board, as shown in the figure.

Now, turn the board so that the rear is again facing you. Locate the fuse near connector J3. In front of the fuse is a capacitor. Look to the immediate right of the capacitor, and you will see three holes as shown in Fig. 5. Connect one end of a 12-inch piece of wire to each of the three poles of the rotary switch, and one to the common, as shown. Solder the wires from each of the poles of the switch to the board as shown.

Now, look at pin 4 of connector J3 (Fig. 6). Follow the pin out of the back of the connector. Locate the wire run

and connection point tied to pin 4, as shown in the figure. Solder the common lead from the switch to this connection point. Next, insert the 7414 IC in the left-hand socket, and the 74LS17 IC in the right-hand socket. Make sure that the notch, or dot, on one end of the ICs faces the keyboard side of the circuit board.

All you need to do now is mount the switches somewhere and connect the peripheral of your choice to the port of your choice. Mounting the switches is easy if you have a Superboard II. Depending on how your case is designed, it's up to you. On a C1P, you can drill two holes at the rear of the cabinet in an area that has sufficient space, and mount the switches. You will also need to provide another small hole for the plug that matches your printer, modem or whatever.

## Conclusion

At this point, I am about to leave you on your own, but let me explain what we have done so that you're not totally in the dark. When the rotary switch is in the pole 1 position, your system loads from cassette, as it did previously. In the pole 2 position, the RS 232/modem, or J3 connector, is

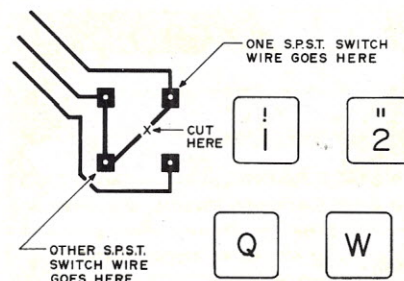


Fig. 4.

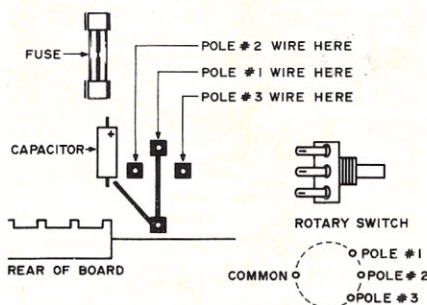


Fig. 5.



Fig. 6.



switched in. In the pole 3 position, the printer port, or J2 connector, is

#### Parts List

- 1 7417 IC
- 1 74LS14 IC
- 6 220 ohm resistors
- 6 390 ohm resistors
- 1 470 ohm resistors
- 1 1k ohm resistor
- 1 4.7k ohm resistor
- 3 10k ohm resistors
- 2 14-pin IC DIP sockets
- 1 1N914 diode
- 1 2N2222 transistor (Radio Shack 276-2009)
- 1 2N2907 transistor (Radio Shack 276-2023)
- 1 12-pin Molex connector (like the one that connects your cassette recorder to your circuit board)
- 1 single pole, three-throw rotary switch
- 1 SPST switch
- 1 connector to match your printer, modem or whatever.
- miscellaneous hardware: hookup wire (no. 22 or 20 gauge), solder, soldering iron, electrical tape, a small piece of aluminum foil.

switched in. The SPST switch, when closed, will enable the CTS (clear to send) function. The rotary switch will control the receive data, so that information could not come into the computer from two sources at the same time. The transmit data will always be present at both J2 and J3 any time you execute a save command.

So, if a printer is hooked up to the J2 port and you type in SAVE and turn on the printer, the data that appears on screen will print on the printer. The clear-to-send switch should normally be left in the closed position. In fact, it *must* be in the closed position when using your cassette deck to load programs. It is only necessary to turn the switch to the open position when using a printer or modem that requires the use of a clear-to-send signal.

The big question that may now remain is, "but how do I hook up my printer?" I wish I could answer that. But, since every peripheral out there is different, there is no one answer to that question. The information in Table 1 will hopefully help you figure out how to do this after comparing the outputs with the inputs needed by your peripheral.

Most printers will need two or three lines; a ground line, a transmit data line or RS-232 data out line; and possibly a clear-to-send line. On some printers, this CLS line is called BUSY or ACKNOWLEDGE.

Most telephone modems will need

both the RS-232 lines, along with clear-to-send and request-to-send, depending on the modem's duplex set-up. If the peripheral is other than a modem or printer, get a full set of spec sheets, because you're on your own.

The RS-232 output lines conform to a standard positive voltage level. Unfortunately, a few printers require a negative voltage level. If your printer is one of them, you can use the RS-232 port to provide an output line to the printer, provided you do two more tasks. Locate points A and B in Fig. 2 for mounting the 1k, 4.7k and 10k resistors. On the underside of the board is a wire run between these two points. You will have to cut it. Then, connect a negative voltage supply between this point and ground, by wiring in a 9-volt battery. The positive lead goes to pin 8, and the negative lead goes to pin 7 of J2. Add a switch to stop battery drain when you're not using the printer.

Also, keep in mind that these are serial ports. They are designed to work with any peripherals that accept serial data, which is most of them. There are some peripherals that require parallel inputs. Stay away from them, if at all possible. You would need considerably more circuitry than is detailed here to make a parallel peripheral work with your serial outputs. If you are into hardware kludging, you can try an interface using a UART chip. ■

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#### Connectors (J2)

Pin #

- 1 Rec data (output to printer or peripheral)
- 2 Rec clock
- 3 Clear to send
- 4 Transmit data (input from peripheral)
- 5 Transmit clock
- 6 Request to send
- 7 through 12—Cassette and video connections. Pins 8 and 11 are ground.

A ground line will need to go to the peripheral.

#### Connectors (J3)

- 1 Ground
- 2 RS-232 data output
- 3 RS-232 data input
- 4 Rec data
- 5 Rec data #1
- 6 Rec data #2
- 7 Negative voltage level for RS-232 (see text)
- 8 not used
- 9 Clear to send
- 10 Clear to send #2
- 11 not used
- 12 not used

Table 1.



Whatever happened to  
eenie, meenie,  
miney, mo?

I could be  
another  
Solomon...

This may put  
the Godfather  
out of business.

If only  
my heart  
would stop  
racing...

It must use  
Bayesian,  
weighted factor  
analysis, and...

Brilliant!  
Like a window  
into the future.

...a perfect  
gift for that  
urban cowgirl!

Maybe this'll  
help me choose  
a career...

I could  
use it to  
select my staff.

Should I  
buy stock  
or commodities  
in this economy?

Would I  
rather have  
Winston's millions  
or Billy Joe's  
love?

Hmmmm...  
could be  
my ticket  
to the Boardroom.

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of these people  
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# A Rat's-Eye View of Mazes

By Brian McC Carson

**B**ehavioral scientists often place rats into mazes to test their reactions. But except at a few elegant British gardens, most human beings never see a maze from the inside. Now, thanks to the Renaissance invention of perspective drawing and the more recent development of microcomputer graphics displays, science can offer man the same perplexing experience as the rat.

Rats is a program for the Apple II that renders a rat's-eye view of the interior of a maze, using the Apple's high-resolution graphics capability. The user is forced to find his way through the twists and turns to the exit without benefit of other orientation.

## Program Use

Once started, the program asks for

the desired maze size, up to a maximum of  $35 \times 27$ . Larger mazes are obviously harder to navigate (and also take longer to generate). You should probably start with something relatively small, about  $5 \times 7$ .

Input is through the keyboard, and comprises three commands: walk forward, face left and face right. The

space bar is used to move forward, and the Apple's left and right arrow keys are used to turn. (Turning doesn't change the location of the observer, but only gives the view in another direction.) After the player has found his way out, the program gives the traditional top view of the maze and traces his perambulations. (Completely frustrated players may wish to yield to the temptation of the Escape key.)

## Program Theory

Rats renders a perspective drawing of the maze from any location within it. Fig. 1 illustrates the perspective art requirement. An observer in a maze facing in the indicated direction from the spot marked X sees the view given in Fig. 2. Those walls which can be seen by the observers are emphasized in Fig. 1. Rats provides a simple algorithm for converting the description of Fig. 1 into the view in Fig. 2.

Fig. 3 gives the top view of an incomplete maze. This maze consists of a set of cells which may or may not

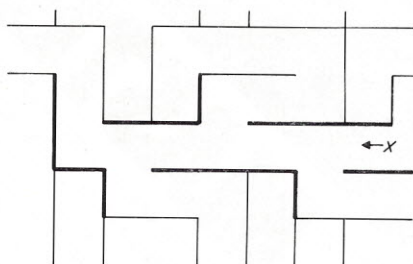


Fig. 1. Portion of a maze.

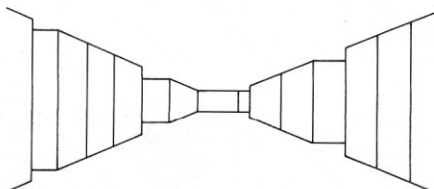


Fig. 2. Perspective view of observer in maze.

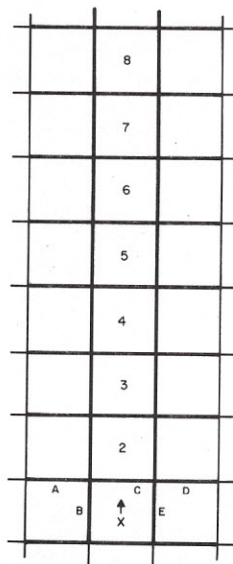


Fig. 3. Prototype maze grid.

Address correspondence to Brian McC Carson, 2922 W. Hartford Drive, Phoenix, AZ 85023.



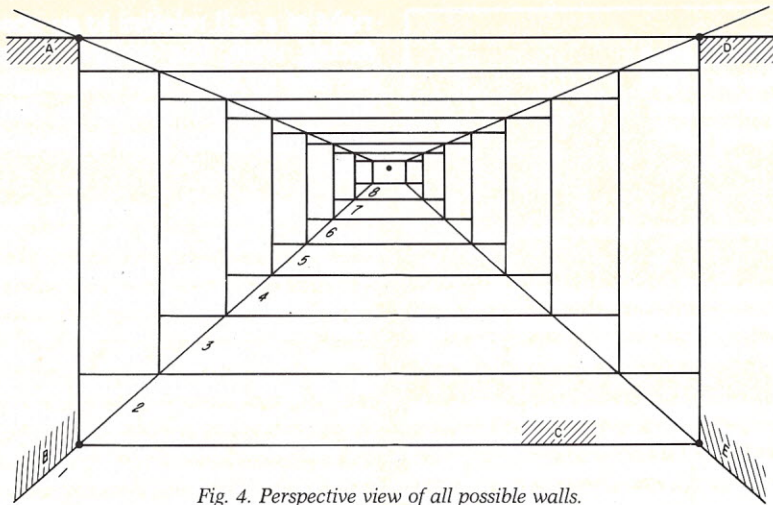


Fig. 4. Perspective view of all possible walls.

have walls. An observer in the maze looks along a row of these cells. According to which walls are present, he may or may not be able to see the indicated walls. Fig. 4 shows the same set of cells and walls as seen by the observer. Notice that this view can be drawn by proceeding through the row of cells along the direction the observer is facing and drawing at each cell each of five possible walls:

- A—the back wall of the left adjacent cell.
- B—the left side wall of the cell.
- C—the back wall of the cell.
- D—the back wall of the right adjacent cell.
- E—the right side wall of the cell.

The artistic rendering of these walls is identical at each cell down the row, only smaller. (In fact, since A and D are mirror images of each other, as are B and E, there are actually only three basic shapes.)

The walls are drawn with the familiar "vanishing point" method of perspective. This means that extensions of all parallel lines moving away from the observer converge at a point (in this case, near the center of the screen). The four vertices of the center walls are the only points required to draw the image. These points are defined by four coordinate pairs composed from four values:

- U—vertical displacement of top line.
- D—vertical displacement of bottom line.
- L—horizontal displacement of left line.
- R—horizontal displacement of right line.

The side walls (B and E) are defined by two successive center walls. The back walls off to the left and right sides (A and D) are defined by the

two side vertices of the center wall and the horizontal coordinate of the previous (nearer) back wall. Fig. 5 illustrates these basic coordinates. Once the nearest wall's vertices are fixed (arbitrarily according to visual aesthetics), subsequent points are calculated by simple geometric formulae by forcing convergence on the vanishing point.

The final artistic requirement is that the walls seem solid and opaque, so that hidden walls cannot be seen by "looking through" a nearer wall. The general solution to this problem in three-dimensional graphics (some-

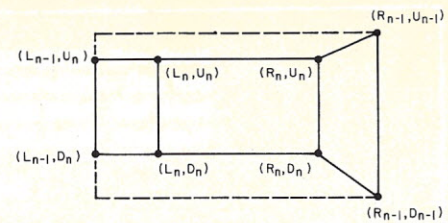


Fig. 5. Coordinates of vertices for basic walls.

times called the "hidden line problem") is quite complex. Fortunately, the restricted geometry of mazes immensely simplifies the task. There are, in fact, only two rules: the center wall blocks off all walls further away, and a side wall masks the back wall (if any) of the adjacent cell on that side.

The flowchart in Fig. 6 shows the basic algorithm used to draw the interior view from an arbitrary point in the maze.

### Program Description

The program uses an interesting technique to increase display speed. The information in the maze variable M is highly redundant. Each element of that array indicates the walls that exist around a single cell. In theory, each cell need only record two walls (say, left and bottom) with the other two walls derived from the walls in

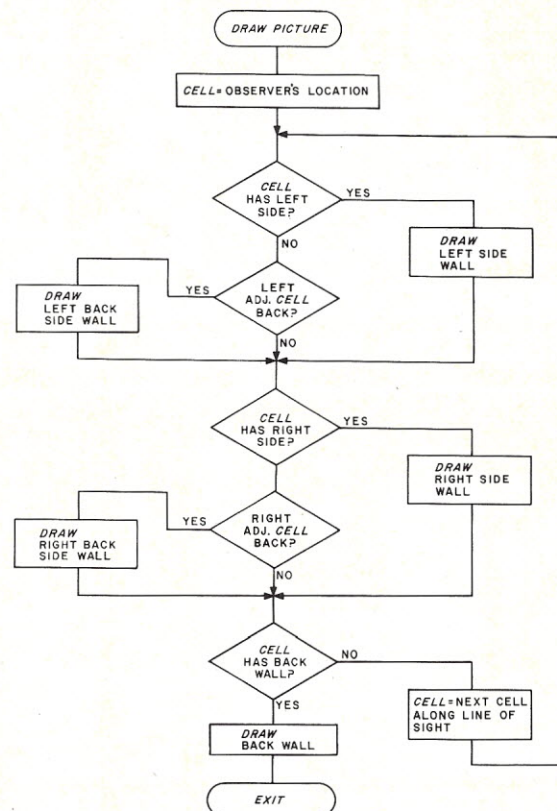


Fig. 6. Flowchart of artwork GOSUB.



North wall	M/128 MOD 2	(observer's front)
East wall	M/64 MOD 2	(observer's right)
South wall	M/32 MOD 2	(observer's rear)
West wall	M/16 MOD 2	(observer's left)

Table 1.

the adjacent cells.

In Rats, not only are all four walls recorded for each cell, but they are recorded twice. Each cell contains eight significant bits, indicating the north, east, south and west walls as:

bit: (msb) 7 6 5 4 3 2 1 0 (lsb)  
wall: N E S W N E S W

To test for the existence of a particular wall at a cell, the program tests the wall's associated bit in the maze array M. The correct bit is isolated by a combination of division by a power of two and a MOD 2 operation, as shown in Table 1.

The division of integers by a power of two acts as a right shift (not directly available in BASIC); it removes all bits less significant than the desired bit, and positions that bit as the low order or least significant bit in the variable. The MOD 2 operation then

eliminates all higher order bits, leaving the calculation result as a simple zero or one for testing in an IF statement.

This redundant encoding of the cell walls is used to assist in rapid transformation of the cell description from the absolute orientation of the maze itself to the orientation of the observer. For example, when the observer is facing east, the south wall of the cell is to the right relative to the observer. With this coding of M, the transformed cell description is achieved by a simple shift (performed in BASIC by multiplication):

observer facing	transformation
North	M
East	M*2
South	M*4
West	M*8

Thus, to test for a side wall on the

right of a cell relative to an observer facing west, the program can test  $M*2/64 \text{ MOD } 2$ . The disadvantage of this redundant coding is that the maze takes more time to generate initially.

The program is written in Apple II Integer BASIC, and uses the HIRES graphics assembly-language subroutines supplied by Apple to draw lines. The graphics are limited to a few places (GOSUBs at 200, 300, 400 and 3100, plus lines 6075 and 6275) so it can be converted to Applesoft BASIC or another machine's BASIC. The maze array variable (M) is actually a two-dimensional array; however, since Apple Integer BASIC doesn't support this, the single subscript is always calculated as  $M(X+Y*FX)$ , where FX is the maximum X coordinate.

You can reduce this program's memory requirement by reducing the M array and the variable FX (lines 860 and 840). The only other functions unique to the Apple are the sound GOSUB at line 500, the CALL -936 at line 820 (which clears the character display screen) and the keyboard single character input at line 5100. ■

# Program listing.

```

1 REM RATS: A 3-D MAZE PERSPECTIVE
10 REM SCREENPLAY BY BRUCE CARLSON
50 POKE 75,16: REM LOMEM
99 GOTO 800
100 REM DRAW 3-D VIEW AT H,V
101 REM
102 REM H,V = CUR LOC COORDS
103 REM S,R = FACING (F)
104 REM A,B = LOOKING COORDS
105 N=2:A=H:B=V:FF=2^(F-1)
108 CALL INIT: POKE HCLR,255
110 Z=M(A+B*FX)*FF
120 REM LEFT SIDE
122 IF ((Z/16) MOD 2)=0 THEN 130
124 RL=-1: GOSUB 400
128 GOTO 140
130 REM LEFT BACK
132 W=M(A+S*(B-R)*FX)*FF
134 IF ((W/128) MOD 2)=0 THEN 140
136 RL=-1: GOSUB 300
140 REM RIGHT SIDE
142 IF ((Z/64) MOD 2)=0 THEN 150
144 RL=-1: GOSUB 400
148 GOTO 160
150 REM RIGHT BACK
152 W=M(A+S*(B+R)*FX)*FF
154 IF ((W/128) MOD 2)=0 THEN 160
156 RL=-1: GOSUB 300
160 REM BACK TEST
162 IF ((Z/128) MOD 2)=1 THEN 180
170 REM NEXT LEVEL
172 N=N+1: IF N>8 THEN 190
174 A=A+R:B=B+S: IF B<2 THEN 190
178 GOTO 110
180 REM BACK END
182 GOSUB 200
190 RETURN
200 REM CENTER BACK SUBROUTINE
210 REM N=DISTANCE
220 X=V+DX(N): POKE HX,X MOD 256
: POKE HX+1,X/256: POKE HY,
YU(N)
225 CALL POSN
230 POKE HY,YD(N): CALL LINE
235 X=V-DX(N): POKE HX,X MOD 256
: POKE HX+1,X/256: CALL LINE
240 POKE HY,YU(N): CALL LINE
245 X=V+DX(N): POKE HX,X MOD 256
: POKE HX+1,X/256: CALL LINE
290 RETURN
300 REM BACK SIDE SUB
310 REM RL=BACK SIDE (-1,+1)
320 X=V+RL*DX(N-1)
325 POKE HX,X MOD 256: POKE HX+
1,X/256: POKE HY,YU(N)
330 CALL POSN
335 X=V+RL*DX(N): POKE HX,X MOD
256: POKE HX+1,X/256
340 CALL LINE
345 POKE HY,YD(N): CALL LINE
350 X=V+RL*DX(N-1): POKE HX,X MOD
256: POKE HX+1,X/256
360 CALL LINE
390 RETURN
400 REM SIDE SUBR
410 REM N=DISTANCE
415 REM RL=WHICH SIDE (-1,+1)
420 X=V+RL*DX(N-1): POKE HX,X MOD
256: POKE HX+1,X/256
425 POKE HY,YU(N-1): CALL POSN
430 X=V+RL*DX(N): POKE HX,X MOD
256: POKE HX+1,X/256
435 POKE HY,YU(N): CALL LINE
440 POKE HY,YD(N): CALL LINE
445 X=V+RL*DX(N-1): POKE HX,X MOD
256: POKE HX+1,X/256
450 POKE HY,YD(N-1): CALL LINE
460 POKE HY,YU(N-1)
470 IF N>2 THEN CALL LINE
490 RETURN
500 REM ERROR SOUND
510 SS=-16336: REM APPLE SPEAKER
520 FOR I=1 TO 12:JU=PEEK(SS)
-PEEK(SS)-PEEK(SS)-PEEK(SS):
(SS)-PEEK(SS)-PEEK(SS):
NEXT I
530 RETURN
800 REM HIRES GRAPHICS LOCATIONS
810 HX=800:HY=802:HCLR=812:LINE=
3786:POSN=3761:INIT=3072
820 TEXT:CALL -936:VTAB 5: TAB
16:PRINT "RATS":PRINT:PRINT
S."
830 POKE HCLR,7: REM WHITE
840 VTAB 13:FX=36: INPUT "MAZE SIZE
(H,V) ",H,V
844 IF H<2 AND H<36 AND V<2 AND
V<28 THEN 850
846 PRINT "2CHC36 2CV<28": GOSUB
500: GOTO 840
850 N=H*V-1:H=H+1:V=V+1
855 D=1
860 DIM M(1209),A$(10),WALK(100
),CUT(5),DX(8),YU(8),YD(8)
870 FOR J=1 TO V+1:JU=J*FX:M(1+
JU)=4:M(HH+1+JU)=1: NEXT J
875 MX=279:MY=157:VX=MX/2:VY=MY/
2+40:X=VX
880 REM COMP. PERSPECTIVE PTS
890 FOR J=1 TO 8:DX(J)=X:YU(J)=
VY-X*VY/VX:YD(J)=VY+X*(VY-VY)
/VX:X=X*7/10: NEXT J
900 JU=(V+1)*FX
910 FOR I=2 TO H:M(I+JU)=8:M(I+
FX)=2
920 FOR J=2 TO V:M(I+J*FX)=15: NEXT
J: NEXT I
940 REM MAZE VALUES, FACING NORTH
942 REM 8=TOP WALL
943 REM 4=RIGHT WALL

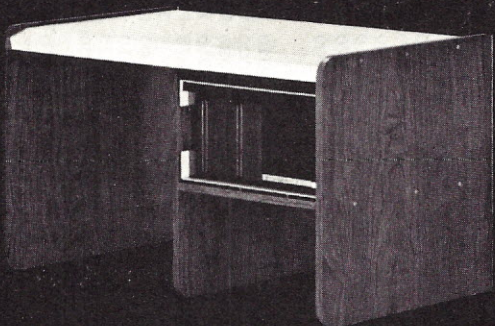
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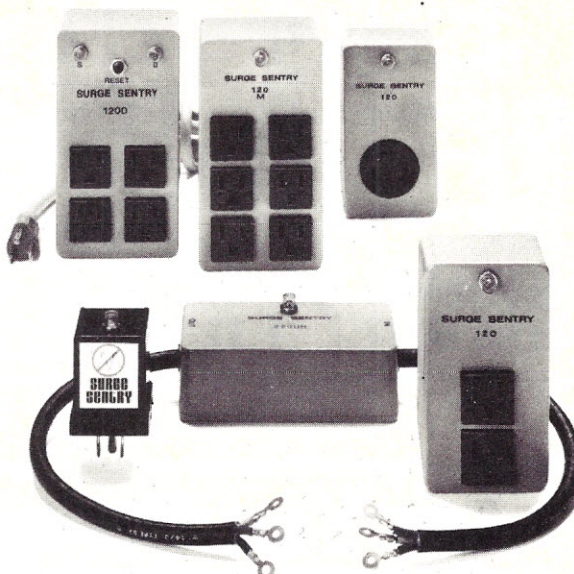
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Thousands of computerists have written programs and could be receiving royalty checks every month but they aren't...and won't, until they do something about publishing their programs. Have you written any microcomputer programs that may be useful to others? Few applications or utilities are unique so the chances are excellent that many of the programs you have written are marketable, **RIGHT NOW!**

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Instant Software can transform your programs into royalty checks. We've set the standard for royalties to programmers. We have the publishing know-how, a world-wide distribution network and can do the most for you in selling the product of your genius.

Submit your programs on tape or disk, with complete documentation, to: Instant Software, Inc., Submissions Dept., Peterborough, NH 03458. If we can't use your program, you should hear from us in a few days. The good news takes a bit longer, but comes in the form of royalty checks.

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## Listing continued.

```

944 REM 2=BOTTOM WALL
945 REM 1=LEFT WALL
950 REM
951 REM FACE TOP RIT BOT LFT
952 REM N 8 4 2 1
953 REM E 4 2 1 8
954 REM S 2 1 8 4
955 REM W 1 8 4 2
956 REM
960 R=H/2+1:S=V/2+1:M(R+S*FX)=15

970 PRINT "GENERATING MAZE.": GOSUB
500
980 REM GENERATE RANDOM MAZE
985 REM ALGORITHM HERE FROM ROGERS
AND STRASSBERGER
990 FOR IWALK=1 TO N
1000 I=Z
1010 IF M(R-1+S*FX)<15 THEN 1100
1020 I=I+1:CUT(I)=1500
1100 IF M(R+(S-1)*FX)<15 THEN 1200
1110 I=I+1:CUT(I)=1600
1200 IF M(R+1+S*FX)<15 THEN 1300
1210 I=I+1:CUT(I)=1700
1300 IF M(R+(S+1)*FX)<15 THEN 1400
1310 I=I+1:CUT(I)=1800
1400 IF I=0 THEN 2000
1410 IF I#1 THEN I= RND (I)+1
1420 Q=R+S*FX
1450 GOTO CUT(I)
1500 REM MOVE WEST
1510 M(Q)=M(Q)-(M(Q)/4) MOD 2)
1520 R=R-1:Q=R+S*FX
1530 M(Q)=M(Q)-(M(Q)/4) MOD 2)*
4
1550 GOTO 2500
1600 REM MOVE NORTH
1610 M(Q)=M(Q)-(M(Q)/8) MOD 2)*
8
1620 S=S-1:Q=R+S*FX
1630 M(Q)=M(Q)-(M(Q)/2) MOD 2)*
2
1650 GOTO 2500
1700 REM MOVE EAST
1710 M(Q)=M(Q)-(M(Q)/4) MOD 2)*
4
1720 R=R+1:Q=R+S*FX
1730 M(Q)=M(Q)-(M(Q) MOD 2)
1750 GOTO 2500
1800 REM MOVE SOUTH
1810 M(Q)=M(Q)-(M(Q)/2) MOD 2)*
2
1820 S=S+1:Q=R+S*FX
1830 M(Q)=M(Q)-(M(Q)/8) MOD 2)*
8
1850 GOTO 2500
1900 REM SCAN FOR UNUSED PT.
2000 IF D=-1 THEN 2100
2010 IF R#H THEN 2300
2020 IF S#V THEN 2200
2030 R=2:S=2: GOTO 2400
2100 IF R#2 THEN 2300
2110 IF S#V THEN 2200
2120 R=H:S=2: GOTO 2400

```

```

2200 S=S+1:D=-D: GOTO 2400
2300 R=R+D
2400 IF M(R+S*FX)=15 THEN 2000
2450 GOTO 1000
2500 NEXT IWALK
3000 MH=H:MV=V
3001 REM RANDOM PT AT SOUTH AS START
ING POINT
3005 I= RND (MH-1)+2
3010 M(I+1*FX)=0
3015 II=I+2*FX:M(II)=M(II)-((M(II)
/8) MOD 2)*8
3020 H= RND (MH-1)+2
3030 H1=H:V1=V
3050 GOSUB 500
3080 VTAB 23: TAB 12: PRINT "MAZE COM
PLETED.": GOSUB 500
3090 GOTO 3600
3100 REM DISPLAY TOP VIEW OF MAZE
3140 REM CALC DISPLAY SCALE
3150 HZ=278/MH:VZ=158/MV
3200 CALL INIT: POKE HCLR,255
3231 POKE HX,1+HZ: POKE HX+1,0: POKE
HY,1+VZ: CALL POSN
3232 POKE HY,MV*VZ+1: CALL LINE
3240 FOR J=1 TO MV
3250 FOR I=2 TO MH
3260 N=M(I+J*FX):X=I*HZ+1:Y=J*VZ+
1
3290 IF ((N/2) MOD 2)=0 THEN 3400
3299 REM DRAW SOUTH WALL
3300 POKE HX,X MOD 256: POKE HX+
1,X/256: POKE HY,Y: CALL POSN
3330 POKE HX,(X-HZ) MOD 256: POKE
HX+1,(X-HZ)/256: CALL LINE
3400 IF ((N/4) MOD 2)=0 THEN 3500
3405 REM DRAW EAST WALL
3410 POKE HX,X MOD 256: POKE HX+
1,X/256: POKE HY,Y: CALL POSN
3450 POKE HY,(Y-VZ): CALL LINE
3500 NEXT I
3510 NEXT J
3530 REM MARK RAT'S POSITION
3535 X=H*HZ-1:Y=V*VZ-1
3540 POKE HX,(X+1) MOD 256: POKE
HX+1,(X+1)/256: POKE HY,Y+1
: CALL POSN
3545 POKE HX,(X-HZ+2) MOD 256: POKE
HX+1,(X-HZ+2)/256: POKE HY,
Y-VZ+2: CALL LINE
3550 POKE HY,Y: CALL POSN
3555 POKE HX,(X+1) MOD 256: POKE
HX+1,(X+1)/256: POKE HY,Y-VZ+
2: CALL LINE
3590 RETURN
3600 REM ADD REDUNDANT BITS
3610 FOR X=1 TO MH: FOR Y=1 TO MV
3620 I=X+Y*FX:M(I)=M(I)+M(I)*16
3650 NEXT Y: NEXT X
5000 REM PLAY
5001 REM RANDOM INITIAL DIRECTION
5005 F= RND (4)+1: GOTO 5010+F
5010 F=1:R=0:S=-1
5011 R=0:S=-1: GOTO 5020
5012 R=+1:S=0: GOTO 5020

```

```

5013 R=0:S=+1: GOTO 5020
5014 R=-1:S=0
5020 PRINT "LEFT ARROW <- TO TURN LEF
T."
5022 PRINT "RIGHT ARROW -> TO TURN RI
GHT."
5024 PRINT "SPACE BAR TO GO FORWARD."

5040 GOSUB 100
5090 REM GET KEYSTROKE
5100 K= PEEK (-16384): IF K<128 THEN
5100
5110 POKE -16384,0
5120 IF K=136 THEN 5200: REM <-
5130 IF K=149 THEN 5300: REM ->
5140 IF K=160 THEN 5400: REM SPACE
5150 IF K=155 THEN 5700: REM ESC
5160 GOSUB 500: GOTO 5020
5200 REM LEFT <-
5210 F=F-1: IF F<1 THEN F=4
5220 GOTO 5350
5300 REM RIGHT ->
5310 F=F+1: IF F>4 THEN F=1
5350 GOTO 5360+F
5361 R=0:S=-1: GOTO 5370
5362 R=1:S=0: GOTO 5370
5363 R=0:S=+1: GOTO 5370
5364 R=-1:S=0: GOTO 5370
5370 GOTO 5500
5400 REM FORWARD
5410 Z=M(H+V*FX)
5415 T=Z*2 ^ (F-1):T=(T/128) MOD
2
5430 IF T=0 THEN 5450
5435 REM BUMPED INTO WALL
5440 GOSUB 500: GOTO 5100
5450 NM=NM+1: VTAB 22: TAB 34: PRINT
"MOVE ":NM
5455 IF NM<100 THEN WALK(NM)=F
5460 H=H+R:V=V+S
5480 IF V<2 THEN GOTO 6000
5500 GOSUB 100
5590 GOTO 5100
5700 REM ESCAPE
5710 GOSUB 3100
5720 GOTO 5100
6000 PRINT : PRINT "CONGRATULATIONS,
YOU'RE OUT IN "NM;" STEPS."

6010 GOSUB 500
6020 V=V1:H=H1: GOSUB 3100
6030 REM DRAW PATH WALKED
6050 X=H*HZ-HZ/2:Y=V*VZ-VZ/2
6075 POKE HX,X MOD 256: POKE HX+
1,X/256: POKE HY,Y: CALL POSN
6100 FOR N=1 TO NM
6110 IF N>100 THEN 6300
6125 F=WALK(N)
6150 IF F=1 THEN V=V-1
6175 IF F=2 THEN H=H+1
6200 IF F=3 THEN V=V+1
6225 IF F=4 THEN H=H-1
6250 X=H*HZ-HZ/2:Y=V*VZ-VZ/2
6275 POKE HX,X MOD 256: POKE HX+
1,X/256: POKE HY,Y: CALL LINE
6300 NEXT N
6999 END

```



# DIMENSION 3

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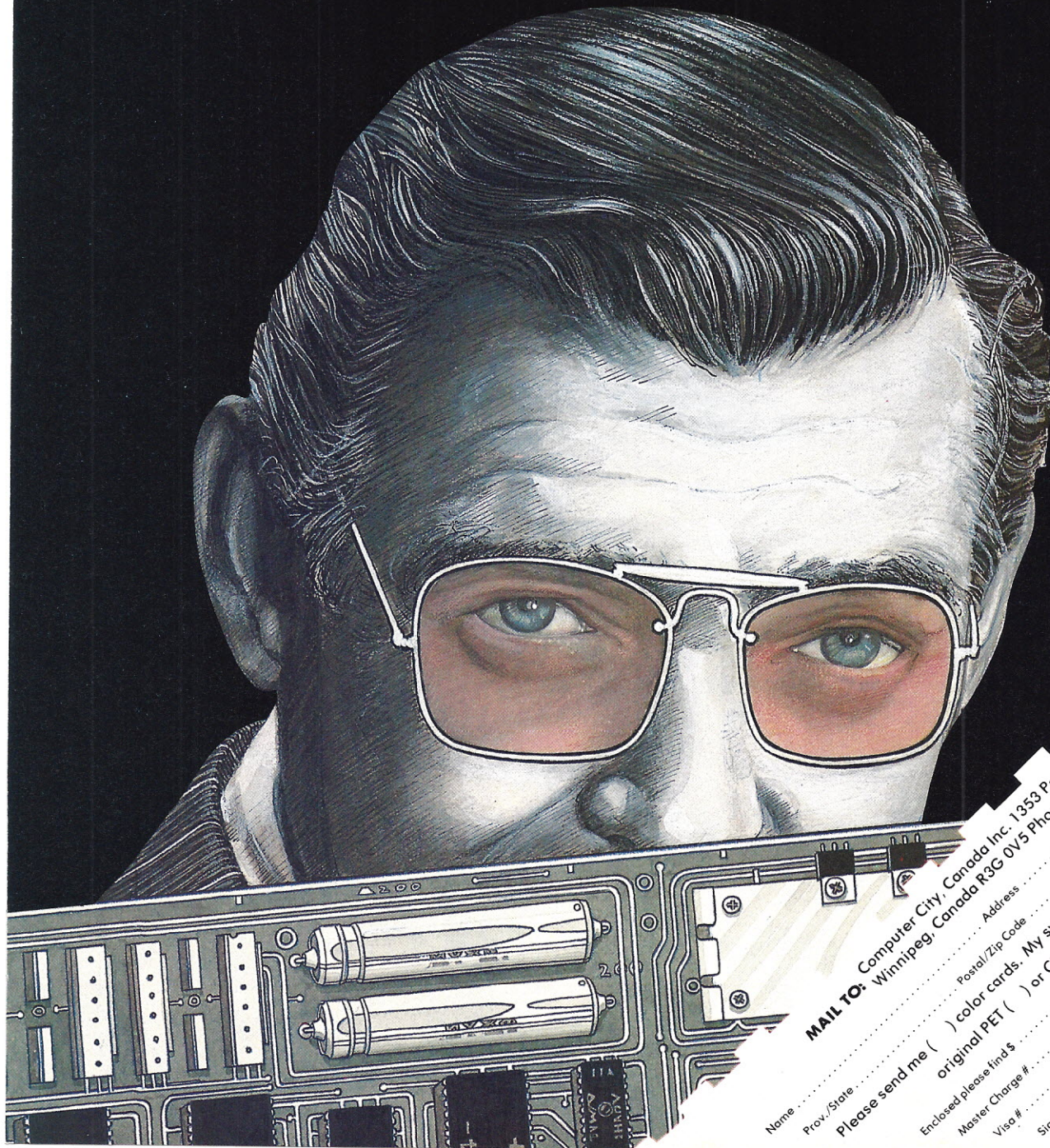
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# Your vehicle for com The Challenger 8P DF.

The general purpose microcomputer was first introduced as a computer for hobbyists and experimenters. However, as the industry has grown, microcomputers have become specialized for personal use or for small business use. There is virtually no computer for the serious experimenter with one important exception, the Ohio Scientific Challenger 8P.

The C8P is unique in that it incorporates the features of state-of-the-art personal computers, with the memory and disk storage capacity of business computers, along with the "mainframe" bus architecture and open ended expansion capability of industrial control computers.

## Personal Computer Features

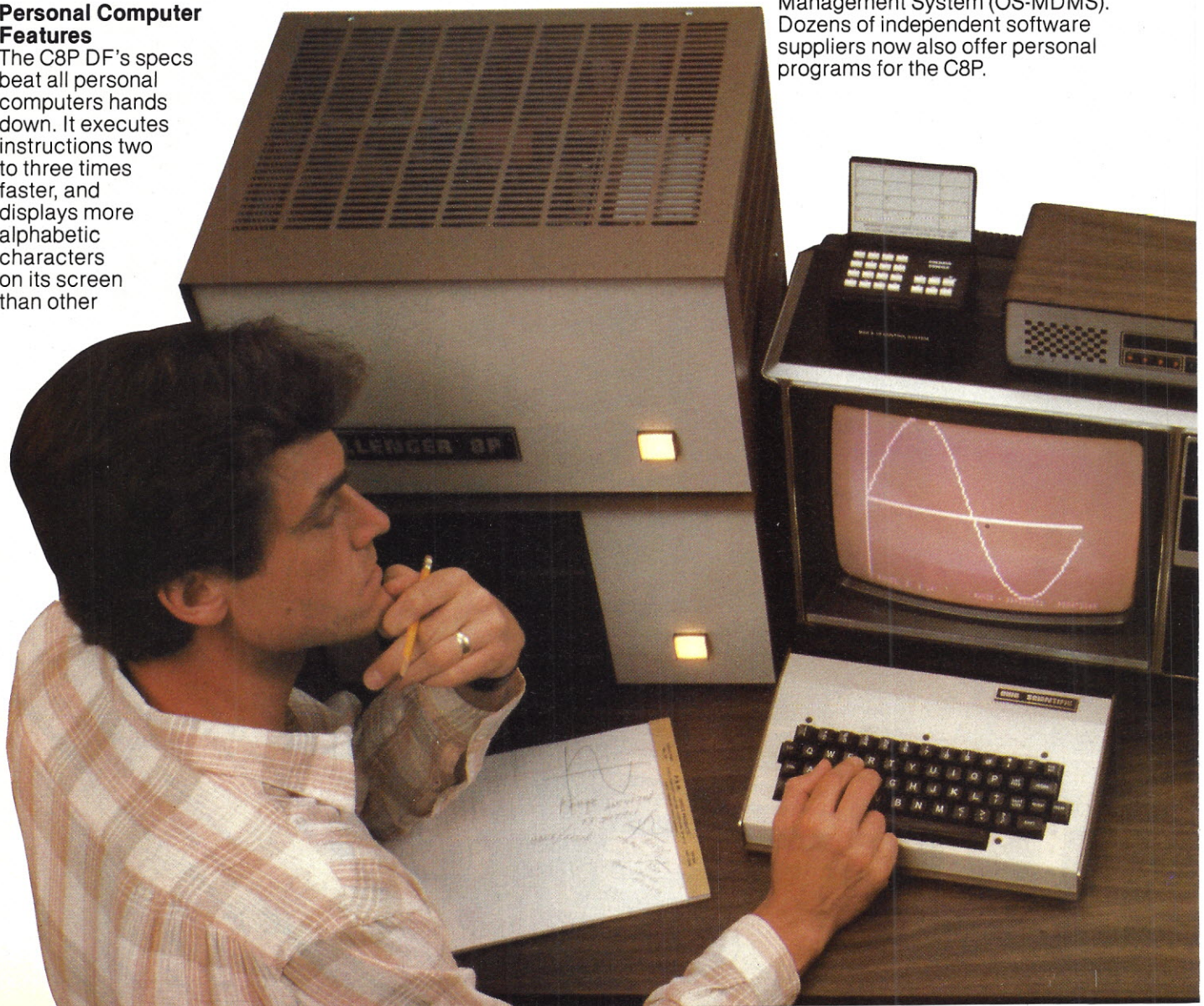
The C8P DF's specs beat all personal computers hands down. It executes instructions two to three times faster, and displays more alphabetic characters on its screen than other

models. It has upper and lower case and graphics in 16 colors. The C8P's standard I/O capabilities are far more extensive than any other computer, with joystick and keypad interfaces, sound output, an 8-bit D/A converter, 16 parallel I/O lines, modem and printer interfaces, AC remote control and security monitor interfaces and a universal accessory port that accepts a prom blaster, 12-bit analog I/O module, solderless prototyping board and more.

Ohio Scientific offers a large library of personal applications programs, including exciting action games such as Invaders and Star Trek, sports simulations, games of logic

and educational games, personal applications such as biorhythms, calorie counter, home programs such as checking and savings account balancers and a home budgeter just to name a few. A new Plot BASIC makes elaborate animations easy, and music composition program allows you to play complex multi-part music through the computer's DAC.

At the systems level the machine comes standard with OS-65D, an advanced disk operating system with Microsoft BASIC and an interactive Assembler Editor. Optional software includes UCSD PASCAL and FORTRAN and an Information Management System (OS-MDMS). Dozens of independent software suppliers now also offer personal programs for the C8P.





# puter explorations.

## Business Computer Features

The C8P DF utilizes dual 8" floppy disk drives which store up to eight times as much information as personal computer mini-floppies, and an available double-sided option expands capacity to 1.2 megabytes of on-line storage. The C8P DF is compatible with Ohio Scientific's business computer software, including OS-65U an advanced operating system, and an Information Management System (OS-DMS) with supplementary inventory, accounting, A/R-A/P, payroll, purchasing, estimation, educational grading and financial modeling packages. The system also supports word processing (WP-3) and a fully integrated small business accounting system (OS-AMCAP V1.6). The C8P DF's standard modem and printer ports accept high-speed matrix printers and word-processing printers directly.

## Home Control and Industrial Control

The C8P DF has the most advanced home monitoring and control capabilities ever offered in a computer system. It incorporates a real time clock and a unique FOREGROUND/BACKGROUND operating system which allows the computer to function with normal BASIC programs, at the same time it is monitoring external devices. The C8P DF comes standard with an AC remote control interface, which

allows it to control a wide range of AC appliances and lights remotely, without wiring, and an interface for home security systems which monitors fire, intrusion, car theft, water levels and freezer temperature, all without messy wiring. In addition, the C8P DF can accept Ohio Scientific's Votrax voice I/O board and/or Ohio Scientific's new universal telephone interface (UTI). The telephone interface connects the computer to any telephone line. The computer system is able to answer calls, initiate calls and communicate via touch-tone signals, voice output or 300 baud modem signals. It can accept and decode touch-tone signals, 300 baud modem signals and record incoming voice messages. These features collectively give the C8P DF capabilities to monitor and control home functions with almost human-like capabilities.

For process control applications, a battery back up calendar clock with automatic computer restart capabilities is available. Ohio Scientific's unique accessory ports allow the connection of a nearly unlimited number of 48 line parallel I/O cards and 12-bit high speed instrumentation quality analog I/O modules to the computer by inexpensive 16-pin ribbon cables.

## Exploring New Frontiers

Ohio Scientific's vocalizer software processes normal BASIC print statements with conventional spellings and speaks them clearly in real-time

on computers equipped with the UTI (CA-15B or CA-14A). This voice output capability, combined with the C8P's remote control, remote sensing, telephone interface capabilities and reasonable cost open up new frontiers for computer applications.

## Documentation

The C8P DF is not a beginner's computer and doesn't come with beginner's documentation. However, Ohio Scientific does offer detailed documentation on the computer which is meaningful for experts, including a Howard Sams produced hardware service manual that includes detailed block diagrams, schematics, parts placement diagrams and parts lists. Ohio Scientific is now also offering fully documented Source Code in machine readable form for OS-65D, the Challenger 8P's operating system allowing experimenters and industrial users to customize the system to their specific applications.

## What's Next?

Ohio Scientific is working on a speech recognizer to complement the UTI system, with a several hundred word vocabulary. The company is also developing an 8 megabyte low-cost, add-on hard disk for use in conjunction with natural language parsing to further advance the state-of-the-art in small computers. The modular bus architecture of the C8P assures system owners of being able to make use of these new developments as they become available just as the owner of a 1976 vintage Challenger can directly plug in voice output, the UTI and other current state-of-the-art OSI products.

The C8P DF with dual 8" floppies, BASIC and two operating systems costs about \$3000, only slightly more than you would pay for a dual mini-floppy equipped personal computer with only a fraction of the capabilities of the C8P.

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# Micros Say The Darn'dest Things

By Michael Grady

In recent years, the study of grammar has been revolutionized by the application of such principles as trees, nodes and branching. These are terms familiar to the computer programmer. In fact, the impetus for one kind of linguistic analysis—developed chiefly by MIT's Noam Chomsky and implemented by many others—was computer analysis and computer text-generation of English sentences.

In many ways, the original concept of Chomsky's generative-transforma-

tional grammar has not proven out. But the recreational programmer can still have some fun with it, if he acknowledges the theory's limitations when applied to a microcomputer.

This random fun-sentence program is essentially a variety of random "branching tree" programming. A very limited vocabulary of English words is subclassified into elementary linguistic categories. The computer generates a basic sentence (S\$) by including mandatory, higher-level,

categories in S\$, and randomly choosing to include or not various other, optional, categories.

In actual practice, a high-level category may be required, as for AV\$ in line 1060, but subsequent randomization may reduce the high-level category to the null string, as in lines 1070–1100. The actual vocabulary items that are "plugged into" S\$ are randomly chosen as well, subject to certain constraints discussed later on.

The program is written in Applesoft BASIC and should run without much modification on computers with similar dialects. If you want to include a larger vocabulary, you'll have to dimension each linguistic category array. For arrays of up to 11 elements, however, Applesoft doesn't require dimensioning, and to ease the programming burden, I kept the items for each fundamental category to ten or fewer. The program occupies about 4K of memory.

The program doesn't cover all linguistic rules in English, so some of the "sentences" it generates are only marginally grammatical. Others are "grammatical," in some sense of the term, but include odd word combinations. But that's where the fun lies.

Six sentences appear at a time, and the program loops endlessly as long

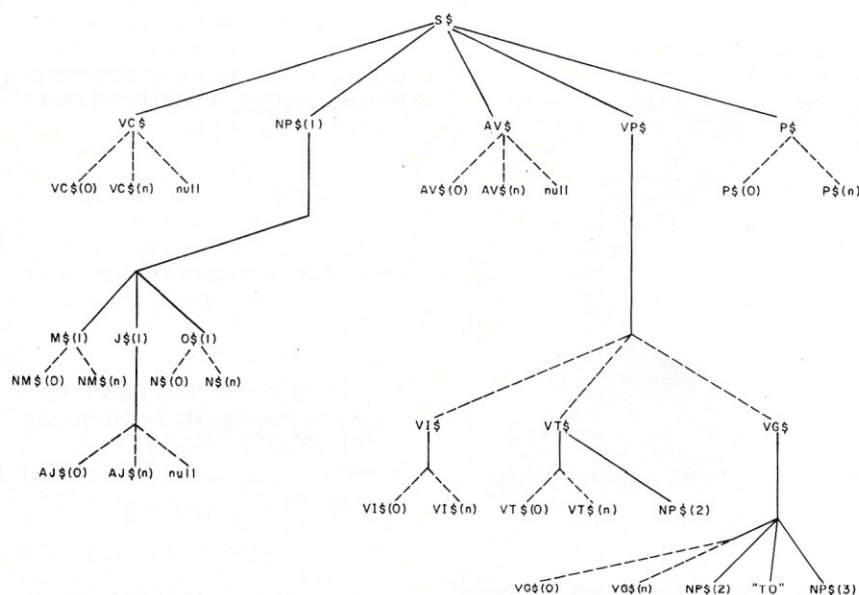


Fig. 1. Random sentence tree. Solid lines indicate mandatory inclusion under a node. Broken lines indicate randomized choices on a given level. The structure for NP\$(2) and NP\$(3) is identical to that given for NP\$(1), but, of course, with the appropriate numerical subscripts.

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as you press "R" each time you're given a prompt. Rarely will you see the same sentence twice. You can extend the vocabulary and categories as you wish, to get even longer and more "creative" sentences, with even less likelihood of duplication. And depending on which words you later decide to drop into the program on your own, you can have either a highly moral sentence generator, or one that would make a stevedore blush.

I'm deliberately not including any sample runs with the listing, so as not to take away the element of shock, surprise and (I hope!) hilarity as the sentences appear on your screen.

### A Few Structural Details

The grammatical categories set up in the program are as follows:

●VC\$(n)—The \$ symbol in Applesoft (and other dialects and languages) indicates an alphanumeric string. The number in parentheses indicates a specific element in an array. Modify according to your computer's dialect, if you don't run Applesoft.

VC is a mnemonic for "vocative," or what some linguists term a "call." It's an attention-getting phrase (or sometimes even a full sentence) that a speaker utters before entering into the heart of his topic. The program requires a VC\$, but in a subsequent operation may assign "nullness" to VC\$, on a random basis.

●NM\$—A mnemonic for the term "noun marker," representing a class of English function-words which don't carry a lot of dictionary meaning but serve as linguistic markers that a noun is coming up. They're also called determiners, articles and possessive pronouns. They all tend to function alike grammatically. An intermediate category of noun marker is termed M\$(n) in the program.

●N\$—Noun, of course. An intermediate string in the program is termed O\$(n) (from nOun. Ns were getting a lot of use, and I had to use an interior letter in this word as a mnemonic).

●NP\$—Noun phrase, a high-level category. This consists of a mandatory noun marker string, an optional adjective string and a mandatory noun (O\$(n)) string.

●VP\$—Verb phrase, another high-level category. A VP\$ consists of a verb of some sort—intransitive, transitive or give—plus whatever might follow the transitive or give verb (at least one NP\$).

●VI\$—Verb intransitive. Those English verbs that don't require a fol-

Listing 1. A random, fun-sentence generator program in Applesoft BASIC.

```

10 HOME
20 REM RANDOM SENTENCE GENERATOR
30 VC$(0) = "LO! "
40 VC$(1) = "MY! "
50 VC$(2) = "HARK! "
60 VC$(3) = "I CAN'T BELIEVE IT! "
70 VC$(4) = "OH, MY LORD! "
80 VC$(5) = "GOODNESS, GRACIOUS, ME: "
90 VC$(6) = "IT'S A FACT! "
100 VC$(7) = "ALAS, "
110 VC$(8) = "OH, "
120 VC$(9) = "ASTOUNDING! "
130 NM$(0) = "THIS "
140 NM$(1) = "THAT "
150 NM$(2) = "HER "
160 NM$(3) = "EACH "
170 NM$(4) = "MY "
180 NM$(5) = "THE "
190 NM$(6) = "OUR "
200 NM$(7) = "HIS "
210 NM$(8) = "YOUR "
220 NM$(9) = "THE "
230 N$(0) = "BOY "
240 N$(1) = "GIRL "
250 N$(2) = "PET SNAKE "
260 N$(3) = "PLUMBER "
270 N$(4) = "POODLE "
280 N$(5) = "DRAGON "
290 N$(6) = "FROG "
300 N$(7) = "BEETLE "
310 N$(8) = "NAUGHTY PART "
320 REM FROM MONTY PYTHON'S TV SERIES!
330 N$(9) = "CHIPMUNK "
340 VI$(0) = "GROWLED "
350 VI$(1) = "DRANK TO A STUPOR "
360 VI$(2) = "EVAPORATED "
370 VI$(3) = "STAGGERED "
380 VI$(4) = "BOUNCED "
390 VI$(5) = "TWIRLS "
400 VI$(6) = "BUZZES "
410 VI$(7) = "LAUGHED "
420 VI$(8) = "EXPLODED "
430 VI$(9) = "COUGHED "
440 VB$(0) = "IS "
450 VB$(1) = "WAS "
460 VB$(2) = "APPEARS "
470 VB$(3) = "SEEMED "
480 VB$(4) = "SOUNDS "
490 VB$(5) = "LOOKED "
500 VB$(6) = "APPEARED "
510 VB$(7) = "REMAINED "
520 VB$(8) = "STAYS "
530 VB$(9) = "SEEMS "
540 VT$(0) = "PUZZLED "
550 VT$(1) = "SMELLS "
560 VT$(2) = "GOOSEED "
570 VT$(3) = "CURSED "
580 VT$(4) = "DEMANDS "
590 VT$(5) = "SHOT "
600 VT$(6) = "WASHED "
610 VT$(7) = "KISSED "
620 VT$(8) = "MOUNTED "
630 VT$(9) = "BROILED "
640 VG$(0) = "GIVES "
650 VG$(1) = "GIVES "
660 VG$(2) = "SENT "
670 VG$(3) = "BROUGHT "
680 VG$(4) = "OFFERED "
690 VG$(5) = "HANDS "
700 VG$(6) = "NAILED "
710 VG$(7) = "THREW "
720 VG$(8) = "DONATED "
730 VG$(9) = "SENDS "
740 AV$(0) = "DELIBERATELY "
750 AV$(1) = "DESPERATELY "
760 AV$(2) = "BENIGNLY "
770 AV$(3) = "OPENLY "
780 AV$(4) = "WITH CONSUMMATE GRACE AND SKILL "
790 AV$(5) = "CHARMINGLY "
800 AV$(6) = "SAVAGELY "
810 AV$(7) = "WISTFULLY "
820 AV$(8) = "DELICATELY "
830 AV$(9) = "SERENELY "
840 AJ$(0) = "BRAVE "
850 AJ$(1) = "GORGEOUS "
860 AJ$(2) = "FURRY "
870 AJ$(3) = "AUSTERE "

```

More →



Listing 1 continued.

```

880 AJ$(4) = "DAINTY "
890 AJ$(5) = "AWE-INSPIRING "
900 AJ$(6) = "SURLY "
910 AJ$(7) = "MAGNIFICENT "
920 AJ$(8) = "IMMACULATE "
930 AJ$(9) = "SCIENTIFIC "
940 PS(0) = "."
950 PS(1) = "!"
960 PS(2) = "?"
970 PS(3) = "!"
980 PS(4) = "."
990 PS(5) = "."
1000 PS(6) = "."
1010 PS(7) = "."
1020 PS(8) = "!"
1030 PS(9) = "?"
1040 DEF FN R(X) = INT ( RND (2) * (10))
1050 FOR N = 0 TO 5
1060 S$ = VC$ + NP$(1) + AV$ + VP$ + P$
1070 X = FN R(X)
1080 IF X = < 4 THEN VC$ = "": GOTO 1110
1090 X = FN R(X)
1100 VC$ = VC$(X)
1110 X = FN R(X)
1120 IF X = < 4 THEN JS(1) = "": GOTO 1150
1130 X = FN R(X)
1140 JS(1) = AJ$(X)
1150 X = FN R(X)
1160 MS(1) = NM$(X)
1170 X = FN R(X)
1180 IF X = 8 THEN X = 2
1190 OS(1) = NS(X)
1200 NP$(1) = MS(1) + JS(1) + OS(1)
1210 X = FN R(X)
1220 IF X = < 4 THEN AV$ = "": GOTO 1250
1230 X = FN R(X)
1240 AV$ = AV$(X)
1250 X = FN R(X)
1260 IF X = < 4 THEN X = FN R(X):VP$ = VS(X): GOTO 1570
1270 X = FN R(X)
1280 IF X = < 4 THEN X = FN R(X):VT$ = VT$(X):T = 1: GOTO 1300
1290 X = FN R(X):VG$ = VG$(X)
1300 X = FN R(X)
1310 IF X = < 4 THEN JS(2) = "": GOTO 1350
1320 X = FN R(X)
1330 JS(2) = AJ$(X)
1340 IF JS(2) = JS(1) THEN JS(2) = "": GOTO 1320
1350 X = FN R(X)
1360 MS(2) = NM$(X)
1370 IF MS(2) = MS(1) THEN MS(2) = "": GOTO 1350
1380 X = FN R(X)
1390 OS(2) = NS(X)
1400 IF OS(2) = OS(1) THEN OS(2) = "": GOTO 1380
1410 NP$(2) = MS(2) + JS(2) + OS(2)
1420 IF T = 1 THEN T = 0:VP$ = VT$ + NP$(2): GOTO 1570
1430 X = FN R(X)
1440 IF X = < 4 THEN JS(3) = "": GOTO 1480
1450 X = FN R(X)
1460 JS(3) = AJ$(X)
1470 IF JS(3) = JS(1) OR JS(3) = JS(2) THEN JS(3) = "": GOTO 1450
1480 X = FN R(X)
1490 MS(3) = NM$(X)
1500 IF MS(3) = MS(1) OR MS(3) = MS(2) THEN MS(3) = "": GOTO 1480
1510 X = FN R(X)
1520 IF X = 8 THEN X = 7
1530 OS(3) = NS(X)
1540 IF OS(3) = OS(1) OR OS(3) = OS(2) THEN OS(3) = "": GOTO 1510
1550 NP$(3) = MS(3) + JS(3) + OS(3)
1560 VP$ = VG$ + NP$(2) + "TO " + NP$(3)
1570 X = FN R(X)
1580 P$ = CHR$(8) + P$(X)
1590 L = LEN (S$): IF L = < 40 THEN A$ = S$: GOTO 1740
1600 FOR B = 39 TO 1 STEP - 1
1610 T$ = MID$(S$,B,1)
1620 IF T$ = CHR$(32) THEN B$ = RIGHT$(S$,L - B):A$ = LEFT$(S$,B): GOTO 1640
1630 NEXT B
1640 L = LEN (B$): IF L = < 40 GOTO 1740
1650 FOR C = 38 TO 1 STEP - 1
1660 T$ = MID$(B$,C,1)
1670 IF T$ = CHR$(32) THEN C$ = RIGHT$(B$,L - C):B$ = LEFT$(B$,C): GOTO 1690
1680 NEXT C
1690 L = LEN (C$): IF L = < 40 GOTO 1740
1700 FOR D = 38 TO 1 STEP - 1
1710 T$ = MID$(C$,D,1)

```

More

lowing noun or adjective.

●VB\$—Verb "become." "Become" is a commonly-occurring verb of this subclass. A variety of the linking verb. In this program, instances of "to be" are also included in the category VB, though on other linguistic grounds "to be" belongs in its own category.

●VT\$—Verb transitive. A verb whose expressed action carries over to a single noun object.

●VG\$—Verb give. A subclass of verb which takes indirect objects as well as direct objects. Named after "give," probably the most frequently-occurring verb in this category.

●AV\$—Adverb. All in the program are manner adverbs, because they lead to funnier results and are simpler to handle linguistically. (Manner adverbs answer the question "How?" Remember?)

●AJ\$—Adjective. Noun modifiers. An intermediate string in the program is called J\$(n).

●PS\$—Punctuation string. Periods, question marks, exclamation marks, all selected randomly and not always appropriately.

### Some Technical Remarks

Line 1040 [1040 DEF FN R(X)=INT (RND(2)\*(10))] takes advantage of the Applesoft provision for creating a user-defined function. In this case, I've defined function R of X as randomly generating an integer between 0 and 9. The number in parentheses after RND must be positive and larger than zero, for X to be randomly generated each time RND is called. The number actually returned is a decimal, and multiplying it by 10 moves the decimal one place to the right, of course. Then the INT function chops off the decimal altogether.

For an expanded vocabulary, the programmer can increase the power of 10 (10 to the second yields values for X ranging from 0 through 99). The only reason I have "10" in parentheses is to preserve it in pristine purity throughout the line renumbering program I've used. Without the parentheses, "10" has come out as various interesting but useless numerals. Line 1070 gives the syntax for the use of FN R, as previously defined.

Line 1180 excludes one noun from occurring in subject position, where it's not compatible with most verbs in the program. If the value returned for X by FN R is 8, then X is revalued as 2. The same thing happens in line 1520, to exclude the same noun from



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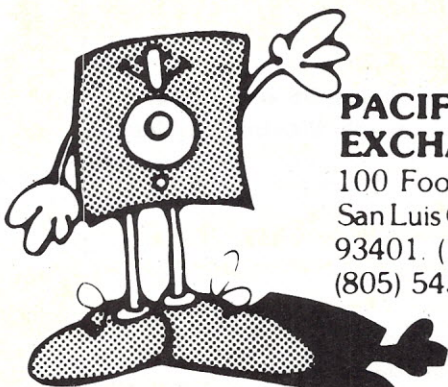
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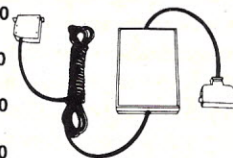
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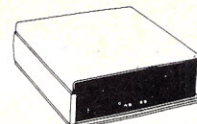
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Listing 1 continued.

```

1720 IF T$ = CHR$(32) THEN D$ = RIGHT$(C$,L - D):C$ = LEFT$(
(C$,D): GOTO 1740
1730 NEXT D
1740 PRINT A$
1750 IF B$ < > "" THEN PRINT B$
1760 IF C$ < > "" THEN PRINT C$
1770 IF D$ < > "" THEN PRINT D$
1780 PRINT :B$ = "" :C$ = "" :D$ = ""
1790 NEXT N
1800 VTab 23: PRINT " <<'E' TO END; 'R' TO RE-RUN.>>": GET X$
1810 IF X$ = "E" THEN END
1820 IF X$ = "R" THEN HOME : GOTO 1050
1830 GOTO 1800

```

indirect object position. But here X is assigned the value 7.

There's a method in this, by the way. I suspected the random numbers returned by FN R were really not all that random, and tested my Apple on runs of 1000 and 10,000 separate randomly generated numbers. In both runs there was a significantly lower return of "2" and "7" than one would expect on a purely randomly generated basis. Lines 1180 and 1520 partially compensate for the glitch.

Line 1080 is the first use of randomization in the program to force an either/or choice. If the random number generated lies within the lower half of the range 0-9, one sequence occurs—in this case, the nulling of VC\$. If the test fails, a new random number is called for, and a different sequence occurs—here the assignment of a specific array element to VC\$. Other array items are assigned to higher-level categories in a similar manner.

Line 1340 is also repeated in spirit throughout the rest of the program. It

is a conditional loop that keeps the same word from being used more than once in a given sentence.

Line 1580 includes CHR\$(8) as the first element of P\$. CHR\$(8) is backspace, and places the punctuation mark that follows just after the last word of the sentence. All vocabulary items in lines 30 through 930 include a trailing space as a word separator, and CHR\$(8) compensates for what would otherwise be a noticeable gap at the end of a sentence.

Lines 1590-1730 format the screen display for Apple's 40-character line. The program lines assure that only full words will appear on each screen line (i.e., wrap-around is eliminated). If you have one of the various add-on boards giving an 80-character screen line, or if you decide to off-print hard copy, you might want to modify these programs lines.

Lines 1750-1770 require the printing of B\$, C\$ and D\$ if they are not null. "<>" is to be read as "is not equal to," and "" symbolizes the null string. B\$, C\$ and D\$ have been created from S\$ for the reason dis-

cussed in the previous paragraph.

Line 1780 inserts a blank line between sentences, then nulls B\$, C\$ and D\$. Otherwise, if the next sentence generated has fewer than 40 characters, B\$, C\$ and D\$ will "tag along" and be printed a second time. A\$ is redefined automatically in line 1590 on each cycle.

Finally, although I have Dan Paymar's lowercase adapter installed in my Apple, I haven't yet figured out an easy way of getting uppercase and lowercase screen output for this program. It is possible to include a loop that reads each character in A\$, except the first, and converts it to lowercase. But when I tried such a loop, it slowed down execution enormously, and wasn't really worth it.

Another possibility is to rewrite the program so that each time it is run it gets input for each category and converts the input to lowercase. Then a subroutine could be written to capitalize only the first letter of A\$. But that would mean reentering each word each time the program is called up.

There are one or two other possibilities, such as using disk data files that are automatically read in when the program runs, but I haven't gotten around to that yet.

### A Last, Mild Caution

While the sentences generated by the following program are not exactly X-rated, some have a certain risque quality. You might want to modify the vocabulary before showing the program off to any visiting elderly female relative. ■

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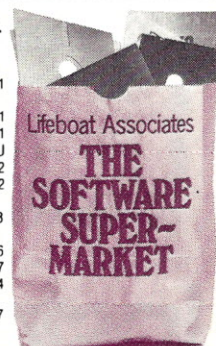
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By Dan Keen and Bob Kenney

Once you learn a little BASIC, it isn't too hard to figure out how to write a program to draw lines on the screen like an Etch-A-Sketch. But with the APF Imagination Machine, you can also make different shapes, in any of eight colors.

Furthermore, you're not limited to graphics. Any alphanumeric character can be printed and changed at any time during drawing, even in reverse video. It's also handy having the joysticks to control the cursor.

```
10 CALL 17046
20 DIM A$(10)
30 X=512: Y=129
35 POKE X,Y
50 A$=KEY$(2)
60 IF A$="N" THEN X=X-32: GOTO35
70 IF A$="S" THEN X=X+32: GOTO35
80 IF A$="E" THEN X=X+1: GOTO35
90 IF A$="W" THEN X=X-1: GOTO35
100 IF A$="2" THEN Y=Y-1: GOTO35
110 IF A$="1" THEN Y=Y+1: GOTO35
120 GOTO 50
```

Program listing.

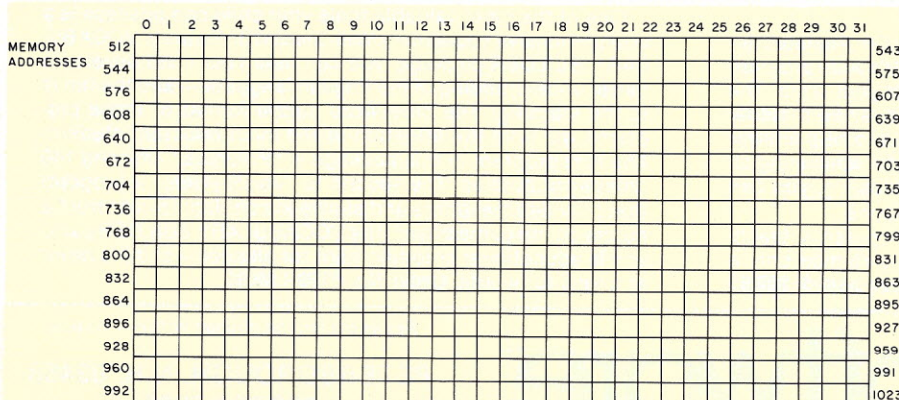


Fig. 2. Video display workshop.

In this program, a cursor, the shape and color of the block that will next be drawn, is displayed on the screen. When you hit the 1 key on the keypad of the left-hand controller, the cursor will change to the next ASCII character. Hitting the 2 will step back to the previous character. This way, you can scan through all the ASCII codes. Due to the machine's ability to handle ASCII numbers that are multiples of the 256 codes, no limit is needed in the program to check to see if the variable Y is less than zero or greater than 256. For example, if Y is 65, the letter A is displayed, as it is if Y equals 321 (65 + 256).

Movement is determined by moving the joystick east, west, north and south.

Since the computer supports wrap-around, you don't need to include program lines to check the vertical or horizontal values to be plotted.

The short program given here is in an experimental form. This is an excellent way to learn about the graph-

ics system in the APF.

Fig. 1 shows the 16 graphics shapes available and the relationship of their color to the ASCII codes. ASCII codes 128 to 143 give green shapes, 144 to 159 draw yellow ones and so on.

For example, a CHR\$(143) displays a dark green box. A CHR\$(143 + 16) is the same shape, only the color is yellow. A blue box is 143 + 32, and so on.

The video memory locations go from 512 to address 1023, as shown in Fig. 2. ■

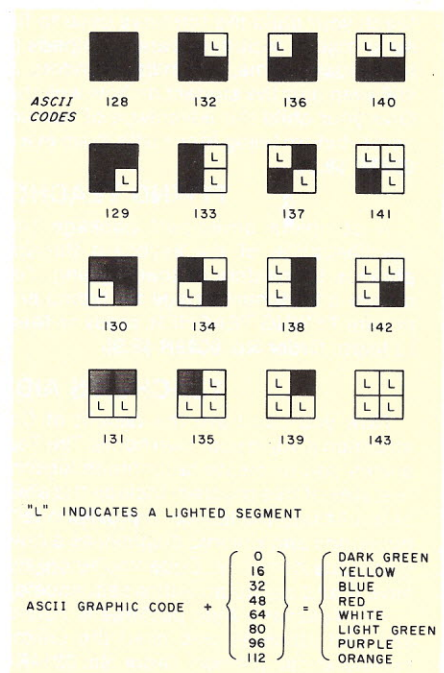


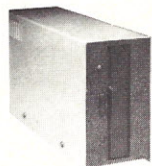
Fig. 1.

Address correspondence to Dan Keen and Bob Kenney, RD 1, Box 432, State Highway 83, Cape May Court House, NJ 08210.



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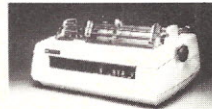
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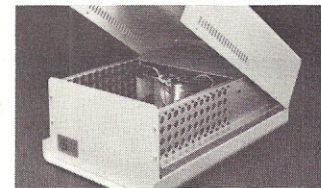
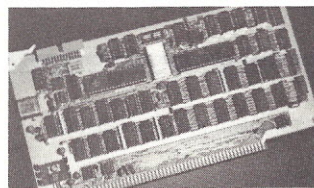
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FLOGEN appears in Listing 3. If you want to customize it, the variable

*b. Flowchart.*

More



Listing 3 continued.

```

0570 D=VAL(T$) :REM DIGIT
0580 FOR J=P+1 TO P+3 :REM LOOK AT NEXT 3 CHARS
0590 T$=MID$(S$,J,1)
0600 GOSUB 3040
0610 IF T=0 GO TO 650 :REM GOT IT ALL
0620 D=D*10+VAL(T$) :REM NEXT DIGIT
0630 NEXT J

0640 REM GOT TARGET LINE NUMBER IN D; NOW STORE IT
0650 S6=S6+1 :REM INCREMENT POINTER
0660 IF C<D THEN S(S6)=C+D/10000 : S1(S6)=1 :REM DOWN REF
0670 IF C>D THEN S(S6)=D+C/10000 : S1(S6)=2 :REM UPWREF

0680 REM CHECK FOR A SERIES OF LINE NUMBERS

0690 IF MID$(S$,J,1)=", " THEN P=J+1 : GO TO 530

0700 REM DONE WITH GOTO, THEN, GOSUB, RESTORE

0710 GOTO 440

0720 REM ENTIRE PROGRAM HAS BEEN SCANNED AND S() HAS S6
0730 REM ENTRIES OF LINE NUMBERS.
0740 REM ON EOF, COME HERE
0750 REM NOW DO A SORT OF S() AND S1()

0760 M=S6
0770 M=INT(M/2)
0780 IF M=0 GOTO 960
0790 K=S6-M
0800 J=1
0810 I=J
0820 L1=I+M
0830 IF S(I)<S(L1) GOTO 920
0840 A=S(I)
0850 S(I)=S(L1)
0860 S(L1)=A
0870 A=S1(I)
0880 S1(I)=S1(L1)
0890 S1(L1)=A
0900 I=I-M
0910 IF I>=1 GOTO 820
0920 J=J+1
0930 IF J>K GOTO 770
0940 GOTO 810

0950 REM SORTING FINISHED. NOW START OUTPUT PASS.

0960 RESTORE #11
0970 LINPUT #11, S$ :REM READ NEXT SOURCE LINE
0980 IF EOF(11)=1 GO TO 2440
0990 C$=LEFT$(S$,5) :REM LINE NUMBER
1000 B=6 :REM NEXT CHARACTER
1010 R4=0 : R5=0 :REM ERASE DIRECTION POINTERS
1020 GOSUB 2570 :REM SEARCH FOR NEXT KEYWORD

1030 REM FIRST KEYWORD IS NOW FOUND. IF FOR OR NEXT
1040 REM UPDATE LEFT MARKERS

1050 L3=0 :REM LEFTMOST POSITION
1060 GOSUB 3110 :REM UPDATE LEFT MARKERS

1070 REM NOW APPEND KEYWORD TO LINE NUMBER

1080 IF K$="STOP" THEN K$="***STOP***"
1090 IF K$="END" THEN K$="***END***"
1100 IF K$="GOSUB" THEN K$="GOSUB-->"
1110 IF K$<>"REM" THEN C$=C$+K$+" "+V$

1120 REM LEFT MARKERS NOW UPDATED. NEXT LOOK FOR MORE
1130 REM KEYWORDS AND REPEAT, IF NECESSARY

1140 B=B+1
1150 A$=MID$(S$,B,1)
1160 IF A$="" GO TO 1320 :REM FINISHED SEARCHING
1170 IF A$<>" " GO TO 1140
1180 B=B+1
1190 A$=MID$(S$,B,1)
1200 IF A$="" GO TO 1180
1210 IF A$<>" " GO TO 1320 :REM FINISHED SEARCHING
1220 GOSUB 2570 :REM SEARCH FOR NEXT KEYWORD
1230 GOSUB 3110 :REM UPDATE LEFT MARKERS
1240 IF K$="STOP" THEN K$="***STOP***"
1250 IF K$="END" THEN K$="***END***"
1260 IF K$="GOSUB" THEN K$="GOSUB-->"
1270 IF K$<>"REM" THEN C$=C$+" : "+K$+" "+V$ :REM SAVE KEYWORD
1280 GOTO 1140

1290 REM LEFT MARKERS AND KEYWORDS ARE TAKEN CARE OF.
1300 REM NOW DO THE RIGHT MARKERS.
1310 REM FIRST, RELEASE A COLUMN WHICH IS PARTIALLY RELEASED

1320 FOR K=1 TO 10
1330 IF R(K)=.5 THEN R(K)=0
1340 IF R(K)=.4 THEN R(K)=0
1350 IF R(K)=1 THEN R(K)=.5
1360 IF R(K)=.9 THEN R(K)=.4

```

More

list in Table 1 will help keep track of which variables are used where.

This version of FLOGEN is written for Percom Super BASIC and runs on an SWTP 6800 system using the Percom floppy-disk system. It can easily be modified to run on 8080, Z-80 or other systems using other microprocessor BASICs.

The important thing is to be able to read BASIC source programs as data files. Almost all disk systems can do this. With little work—reformatting a program tape to be acceptable as data—FLOGEN could also run on a cassette-based system, but the running time would probably be long. This is because FLOGEN reads the source program twice, one line at a time. It takes different amounts of time to read each line, depending on the required processing time, and it would be hard to start and stop the tape just right.

FLOGEN assumes that each line of source code contains a four-digit line number, padded with left-hand zeros if necessary. If your source files are stored in a slightly different way, some modification may be needed.

The second requirement is to have long enough string lengths that an entire line of source code will fit into one string. In this program, the string length is set to 80 characters, with STRING=80 in line 50. As written, FLOGEN also requires that numeric variables be floating point (not integer) and have at least eight significant digits.

Another requirement is to read an entire line of source code at a time, disregarding any commas, quotes, semicolons or other special delimiters. In Percom Super BASIC a special LINPUT statement exists just for that purpose; the new TSC 6800 BASIC has an INPUT LINE statement that does the same. Without this, the source statement

0010 REM AFTER THIS, MULTIPLY THE NUMBERS

is read only up to the comma delimiter and appears as

0100 REM AFTER THIS

In FLOGEN, the LINPUT is used in two places, lines 210 and 970, corresponding to the two passes through the source program. If your BASIC does not have such a special statement, a similar function can be built up out of the following sequence:

```

INPUT A$,W$,X$,Y$,Z$
IF W$<>" " THEN A$=A$+" "+W$
IF X$<>" " THEN A$=A$+" "+X$
IF Y$<>" " THEN A$=A$+" "+Y$
IF Z$<>" " THEN A$=A$+" "+Z$

```



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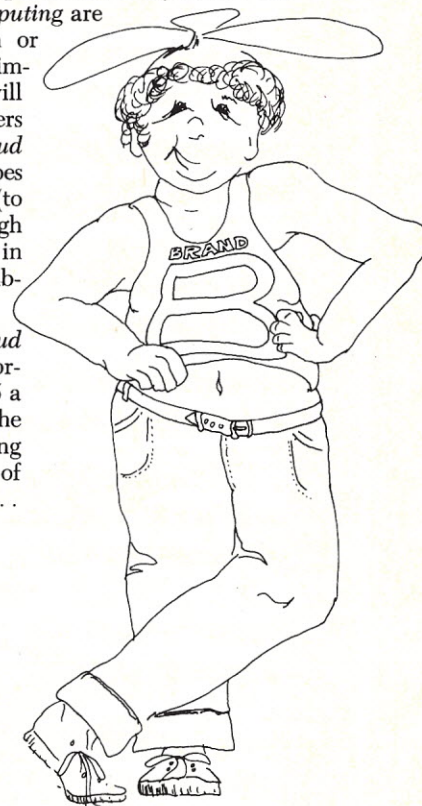
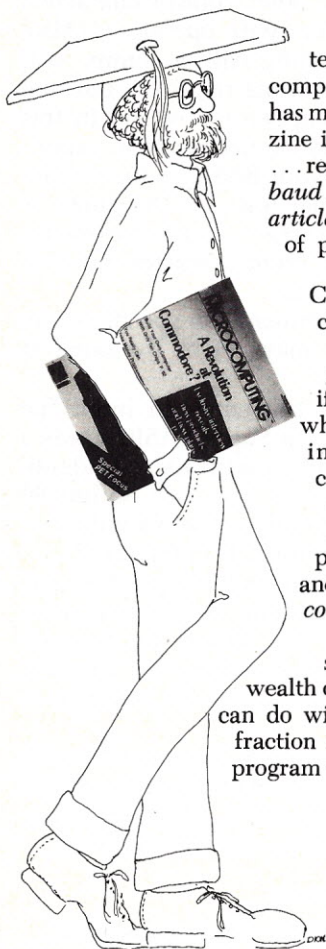
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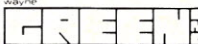


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Listing 3 continued.

```

1370 NEXT K

1380 REM IS THIS LINE THE END OF A TRANSFER FROM/TO ABOVE?

1390 L6=VAL(LEFT$(S$,4)) :REM LINE NUMBER
1400 FOR K=1 TO 10
1410 IF ABS(R(K))<>L6 GO TO 1510

1420 REM THE END OF A TRANSFER. WAS IT FROM OR TO?

1430 IF R(K)>0 GO TO 1490

1440 REM R(K) IS NEGATIVE,SO IT WAS FROM (UP)

1450 IF R5<K THEN R5=K :REM UPDATE ARROW >
1460 R(K)=-9 :REM PARTIALLY RELEASE COLUMN
1470 GOTO 1510

1480 REM R(K) IS POSITIVE,SO IT WAS TO (DOWN)

1490 IF R4<K THEN R4=K :REM UPDATE ARROW <
1500 R(K)=1 :REM PARTIALLY RELEASE COLUMN
1510 NEXT K

1520 REM NEXT,IS THIS LINE THE BEGINNING OF A TRANSFER
1530 REM TO/FROM BELOW? CHECK LINE NO. TABLE

1540 IF S5=S6 GO TO 1600 :REM DON'T INCREMENT PAST END
1550 T=INT(S(S5))
1560 IF T>=L6 GO TO 1600
1570 IF T<>0 THEN PRINT "ERROR - MISSING LINE NUMBER "; T
1580 S5=S5+1
1590 GOTO 1540
1600 IF INT(S(S5))<>L6 GO TO 1940 :REM NO TRANSFER

1610 REM THIS LINE IS THE BEGINNING OF A TRANSFER

1620 D9=(S(S5)-INT(S(S5)))*10000 :REM DESTINATION
1630 S(S5)=0 :REM ERASE IT

1640 REM CAN WE TIE INTO AN EXISTING COLUMN?

1650 FOR K=1 TO 10
1660 IF ABS(INT(R(K)))=D9 GO TO 1700
1670 NEXT K
1680 GOTO 1730 :REM NOTHING MATCHES,CAN'T TIE IN

1690 REM SAME DESTINATION - IS IT THE SAME DIRECTION?

1700 IF S1(S5)=1 THEN IF R(K)>0 GO TO 1830 :REM YES !
1710 IF S1(S5)=2 THEN IF R(K)<0 GO TO 1870 :REM YES ^

1720 REM NEED NEW COLUMN. FIND AN EMPTY ONE

1730 FOR K=10 TO 1 STEP -1
1740 IF R(K)=0 GO TO 1780
1750 NEXT K
1760 GOTO 1890 :REM ALL COLS BUSY,SO IGNORE

1770 REM FOUND AN EMPTY COLUMN. CHECK DIRECTION AND USE IT

1780 IF S1(S5)=1 GO TO 1820 :REM DOWN
1790 IF S1(S5)=2 GO TO 1860 :REM UP
1800 PRINT "ERROR ON "; S$ : STOP

1810 REM DOWN DIRECTION

1820 R(K)=D9.
1830 IF R5<K THEN R5=K
1840 GOTO 1890

1850 REM UP DIRECTION

1860 R(K)=-D9+.5 :REM ADD TEMPORARY MARKER
1870 IF R4<K THEN R4=K

1880 REM NOW CHECK IF THERE ARE MORE TRANSFERS BELOW

1890 IF S5=S6 GO TO 1940 :REM NO MORE
1900 IF INT(S(S5+1))=L6 THEN S5=S5+1 : GO TO 1540

1910 REM NO MORE TRANSFERS BELOW. LEFT AND RIGHT MARKERS ARE
1920 REM NOW PDATED,SO PRINT ENTIRE LINE.
1930 REM FIRST,DO LEFT (FOR-NEXT) MARKERS.

1940 FOR K=1 TO 10
1950 H$(K)="" :REM HORIZONTAL LINE
1960 IF K>L3 THEN H$(K)=""
1970 NEXT K

1980 REM NOW DO LEFT VERTICALS ETC

1990 FOR K=10 TO 1 STEP -1
2000 IF L$(K)="" THEN PRINT #P4,H$(K);H$(K);
2010 IF L$(K)<>"" THEN PRINT #P4,"!";H$(K);
2020 NEXT K

```

More

This sequence can take care of up to four commas or other delimiters in one line of source code. For example, if it reads the source code line

0010 REM AFTER THIS, MULTIPLY THE NUMBERS

the 0010 REM AFTER THIS reads into A\$, and MULTIPLY THE NUMBERS goes into W\$, X\$, Y\$ and Z\$ are empty. Since W\$ is not the empty string "" it is added to the end of A\$ with a comma inserted between W\$ and A\$.

This is an effective method of dealing with the problem, although it is not foolproof. In some BASICs, portions of text enclosed in quotes are deleted, or other control characters may interfere with operation. (Also, any line ending with a comma will have that comma removed, but that shouldn't happen too often.) In this case, it may be necessary to experiment with your BASIC to find the instruction that tests for the quote or other character, and temporarily POKE a different character into it to change the test.

Other comments on specific statements that may not be the same in your BASIC:

Lines 60-100 enter an input file name. Percom Super BASIC needs a 2/ symbol before a file name to identify programs in drive two, so line 90 precedes the file name N\$ with 2/ if the drive number D entered is 2.

Line 200 opens the input file, line 210 reads one line and line 220 tests for end of file. When the program tries to read the next line after the last, line 220 sends the program to line 750.

The MID\$(A\$,S,L) function returns a substring of length L, starting at the Sth character of A\$. LEFT\$(A\$,L) returns the first L characters of A\$.

## How It Works

Lines 10-160 initialize variables.

Line 0170 goes to a subroutine to read K9 keywords from DATA statements. Typical keywords are DIM, REM, LET and any other word that defines a type of BASIC statement.

Line 200 opens the file source program file.

Line 210 starts the main loop, and reads the next line of source program.

Lines 230-240 quickly check the length of this line. Any line having fewer than seven characters cannot be a valid statement.

Line 250 gets the first six characters of the line; this consists of a four-digit



line number, a space and the first character of the line.

Line 270 skips all REM lines.

Lines 290-320 scan through the rest of the source line in A\$, and remove all spaces.

Lines 350-450 now scan through the resulting string, looking for :REM, and for GOTO and THEN. If neither is found, the program goes back to line 210 to read the next line.

If a GOTO or THEN is found, lines 470-550 look at the next few characters to see whether a line number follows. (A THEN could be followed by another statement, instead of a line number.) If not, line 550 sends the program back to look for more. The  $I = I + B$  in line 550 changes the loop counter in the FOR-NEXT loop. It's not good programming practice, but it does save a little time. If your BASIC interpreter objects, just delete this portion of the line.

Once a line number is found, lines 570-630 separate the complete line number from the rest of the line. This line number becomes the destination of a transfer from the current line C, obtained in line 510, to the destination line D, obtained in line 620. Lines 660-670 check whether this is a transfer forward or backward in the program, and store both line numbers into one position of array S(.). The lower of the two is stored in the integer portion, while the higher line number is stored as a fraction.

For instance, a GOTO from line 5678 to line 1234 is stored in S(.) as 1234.5678, which explains why your BASIC must have at least eight-digit floating-point numbers. If you have an integer BASIC or one with fewer than eight digits, you have to store the two line numbers separately in two arrays, perhaps called S(.) and T(.).

At the same time the line numbers are stored in S(.), the corresponding location in array S1(.) holds a 1 if this is a transfer forward (down) in the program, or a 2 if it is a transfer backward (up).

Since ON...GOTO statements can have a series of line numbers separated by commas, line 690 checks for a comma after the line number and goes back to look for more numbers if a comma is found.

Line 710 ends the first pass. At the end of the pass, arrays S(.) and S1(.) hold a cross-reference table of the entire program, listing every transfer within the program except for GO-SUBs and RETURNS.

Lines 760-940 now do a Shell sort

Listing 3 continued.

```

2030 REM NOW PRINT THE KEYWORDS
2040 PRINT #P4,C$;
2050 REM NOW DO THE RIGHT MARKERS.
2060 REM FIRST,FIGURE OUT THE HORIZONTAL LINE

2070 FOR K=1 TO 10
2080   H$(K)=" "
2090   IF K<=R4 GO TO 2150           :REM IF LEFT

2100   REM NO LEFT

2110   IF K>R5 GO TO 2190           :REM NO LEFT AND ALSO NO RIGHT

2120   REM RIGHT,NO LEFT

2130   H$(K)=">"
2140   GOTO 2190
2150   IF K>R5 GO TO 2180           :REM IF LEFT,NO RIGHT
2160   H$(K)="-"                   :REM BOTH RIGHT AND LEFT
2170   GOTO 2190
2180   H$(K)="<"                   :REM LEFT,NO RIGHT
2190 NEXT K

2200 REM NOW SPACE OVER TO THE FIRST COLUMN OF RIGHT MARKERS

2210 IF POS=INT(POS/2)*2 THEN PRINT #P4, " ";
2220 P3=POS
2230 FOR K=P3 TO 49 STEP 2
2240   PRINT #P4,H$(1);" ";
2250 NEXT K

2260 REM NOW PRINT RIGHT VERTICALS ETC.

2270 FOR K=1 TO 10
2280   PRINT #P4,H$(K);
2290   IF R(K)>1 THEN PRINT #P4,"!";
2300   IF R(K)=1 THEN PRINT #P4,"<";
2310   IF R(K)=.9 THEN PRINT #P4,"^";
2320   IF R(K)=.5 THEN PRINT #P4," " ;
2330   IF R(K)=.4 THEN PRINT #P4," " ;
2340   IF R(K)=0 THEN PRINT #P4," " ;
2350   IF R(K)>=0 GO TO 2390           :REM IF NOT UPWARD
2360   IF R(K)=INT(R(K)) THEN PRINT #P4,"^"; : GO TO 2390
2370   PRINT #P4, "<";
2380   R(K)=R(K)-.5                   : REM TOP OF UPWARD TRANSFER
2390 NEXT K
2400 PRINT #P4

2410 REM ALL DONE PRINTING,NOW DO NEXT LINE

2420 GOTO 970

2430 REM END OF PRINTING; FINISH UP

2440 CLOSE #11

2450 REM CHECK IF THERE ARE ANY LEFTOVER MARKERS

2460 FOR K=1 TO 10
2470   IF L$(K)<>" THEN PRINT "ERROR - MISSING NEXT ";L$(K)
2480 NEXT K
2490 FOR K=1 TO 10
2500   IF R(K)>1 GO TO 2530
2510   IF R(K)<0 GO TO 2530
2520   GOTO 2540
2530   PRINT #P4, "ERROR - MISSING LINE NO. ";INT(R(K))
2540 NEXT K
2550 END

2560 REM SUBROUTINE TO SEARCH LINE FOR NEXT KEYWORD

2570 FOR K=1 TO K9
2580   L=LEN(K$(K))
2590   IF MID$(S$,B,L)=K$(K) GO TO 2750
2600 NEXT K

2610 REM DIDN'T FIND,SEE IF IT'S AN IMPLIED LET

2620 FOR K=B TO 90
2630   T$=MID$(S$,K,1)
2640   IF T$=" " GO TO 2730
2650   IF T$=";" GO TO 2730
2660   IF T$="," GO TO 2700
2670 NEXT K
2680 PRINT "ERROR - UNDECIPHERABLE STATEMENT" : STOP

2690 REM FOUND AN =,ASSUME A LET

2700 T$=MID$(S$,B,K-B+1) : K=0
2710 GOTO 2750

2720 REM DIDN'T FIND ANYTHING; IS IT AN ERROR?

2730 K=K9

```

More



Listing 3 continued.

```

2740 GOTO 2750
2750 K$=T$
2760 IF K<>0 THEN K$=K$(K)
2770 V$=""

2780 REM FOR A FOR OR NEXT,GET THE VARIABLE TOO

2790 IF K$="FOR" GO TO 2830
2800 IF K$="NEXT" GO TO 2950
2810 RETURN

2820 REM AFTER A FOR,GET EVERYTHING TO =

2830 FOR K=B+3 TO 80
2840     IF MID$(S$,K,1)="" GO TO 2880
2850 NEXT K
2860 PRINT "ERROR IN LINE ";S$ : STOP

2870 REM FOUND AN = AT POSITION K

2880 A$=MID$(S$,B+3,K-B-3) :REM VARIABLE

2890 REM NOW DELETE SPACES FROM IT

2900 FOR K=1 TO LEN(A$)
2910     IF MID$(A$,K,1)<>" " THEN V$=V$+MID$(A$,K,1)
2920 NEXT K
2930 RETURN

2940 REM AFTER NEXT,GET EVERYTHING TO STATEMENT DELIMITER

2950 FOR K=B+4 TO 80
2960     IF MID$(S$,K,1)="" GO TO 3010
2970     IF MID$(S$,K,1)=":" GO TO 3010
2980 NEXT K
2990 PRINT "ERROR IN LINE "; S$ : STOP

3000 REM FOUND DELIMITER AT POSITION K

3010 A$=MID$(S$,B+4,K-B-4) :REM VARIABLE
3020 GOTO 2900

3030 REM SUBROUTINE TO TEST CHARACTER T$ FOR A DIGIT
3040 REM T=1 FOR DIGIT,T=0 FOR NON-DIGIT

3050 T=0
3060 IF T$<"0" THEN RETURN
3070 IF T$>"9" THEN RETURN
3080 T=1
3090 RETURN

3100 REM SUBROUTINE TO UPDATE LEFT MARKERS

3110 IF K$="NEXT" GO TO 3240
3120 IF K$<>"FOR" THEN RETURN

3130 REM IT'S A FOR. FIND THE LEFTMOST EMPTY COLUMN FOR IT
3140 REM AND PLACE A MARKER FOR IT

3150 FOR K=10 TO 1 STEP -1
3160     IF L$(K)="" GO TO 3200
3170 NEXT K
3180 PRINT "ERROR - TOO MANY NESTED LOOPS IN "; S$ : STOP

3190 REM FOUND AN EMPTY COLUMN. ASSIGN IT TO A VARIABLE

3200 L$(K)=V$
3210 IF L3<K THEN L3=K
3220 RETURN

3230 REM IT'S A NEXT. DELETE LEFT MARKER

3240 FOR K=1 TO 10
3250     IF L$(K)=V$ GO TO 3290
3260 NEXT K
3270 PRINT "ERROR? - NEXT WITHOUT FOR?"
3280 RETURN
3290 IF L3<K THEN L3=K
3300 L$(K)="" :REM ERASE MARKER
3310 RETURN

3320 REM SUBROUTINE TO READ K9 KEYWORDS

3330 FOR K=1 TO K9
3340     READ K$(K)
3350 NEXT K
3360 RETURN
3370 DATA DIM,DEF,FOR,NEXT,IF,RETURN,READ,INPUT
3380 DATA LINPUT,PRINT,OPEN,CLOSE,RESTORE,GOTO
3390 DATA GOSUB,ON,REM,GO TO,END,DATA,STOP
3400 DATA CHAIN,DIGITS=,LET,LINE=,POKE,PORT=
3410 DATA SCRATCH,STRING=,TRACE,FILESZ=
3420 DATA ***

```

of S( ) and sort S1( ) into the same order as S( ). This table is now used by pass two to plot transfers on the right of the flowchart.

To see what this transfer table does, look at the following program

```

10 X=1
20 GO TO 30
30 GO TO 10

```

After pass one, but before the table is sorted, S( ) and S1( ) have the following two entries each:

```

S(1)=20.0030    S1(1)=1 (down)
S(2)=10.0030    S1(2)=2 (up)

```

After S( ) is sorted, the two arrays now have:

```

S(1)=10.0030    S1(1)=2 (up)
S(2)=20.0030    S1(2)=1 (down)

```

These tables later tell FLOGEN that there should be a connection from line 10 to line 30 with arrows up, and a connection from line 20 to line 30 with arrows down.

Pass two starts in line 960 when the file is restored to the beginning. Lines 970-980 then read each line, starting from the beginning, and check for end of file.

Line 990 gets the first five characters of the line, which is the line number and a space. B in line 1000 then points to the next character in the line.

Line 1010 now initializes two variables called R4 and R5. These are used when < or > is printed on the right-hand side of transfers to indicate how far the transfers should go. Figure 1 shows how a line of the flowchart can be considered as divided into FOR-NEXT columns L10 through L1 on the left, and transfer columns R1 through R10 on the right. This line shows that we need left arrows out of column R7; variable R4 holds the column number to which we need to extend left arrows <; variable R5 holds the column to which we need right arrows >. In this case, R4 equals 7 and R5 equals 0 since no right arrows are needed.

Line 1020 goes to a subroutine that searches the source line for keywords (it compares the keywords read out of the DATA statements against the line).

Lines 1050 and 1060 now go to work on FOR-NEXT statements via a subroutine starting at line 3100. Whenever a FOR statement is found, the subroutine finds the leftmost empty FOR-NEXT column, starting from L10, and places a marker in it. These markers are held in array L\$( ) and consist of the loop variable.

In the example of Fig. 1, lines 3150 through 3180 search through L\$( ) for



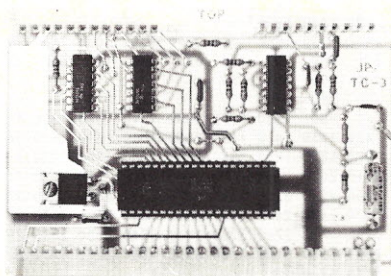
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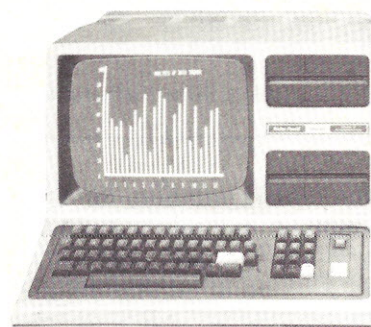
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change direction from vertical to horizontal or vice versa.

Finally, lines 2440-2550 close the file and check for any leftover markers indicating an unfinished FOR-NEXT loop or a downward transfer that started at some GOTO or THEN and never reached a destination.

### Modifications

Assuming that your printer has about 72 columns, the program is set up for up to ten nested FOR-NEXT loops on the left, and for up to ten down or up transfers on the right. It's not likely that you'll have more than ten nested FOR-NEXT loops, but it is possible to run out of space on the right for transfers.

If your printer can print more than 80 columns across the page, you can expand the transfer columns to as much as 20. Find all the FOR K=1 TO 10 and FOR K=10 TO 1 STEP -1 statements that refer to transfer columns and change the 10 to 20; the DIM statement in line 140 is already set up for that.

This version of FLOGEN runs in a 32K system with about 22K RAM left over after the BASIC interpreter. In smaller systems, remove all REMs and reduce the size of arrays S( ), S1( ), R( ) and H( ). Reducing the size of S( ) and S1( ) allows fewer transfers in a program before the arrays overflow. The present limit of 250 transfers is too big for most programs anyway.

FLOGEN purposely does not plot transfer arrows for GOSUB statements to cut down on the complexity of the flowchart. If you want your GOSUBs plotted, add the following statement:

```
0415 IF MID$(S$,I,5) = "GOSUB" THEN B=5
      GO TO 510
```

and delete lines 1100 and 1260.

This version of the program has 32 keywords, but you can easily add or remove keywords; just change the DATA statements at the end and change K9 to fit. Three asterisks should always mark the end of the keyword table.

FLOGEN is complex and takes time to run. If you want to keep tabs on what it is doing, add some additional printouts. One useful one is 0225 PRINT A\$.

Although this program is written for a particular BASIC, feel free to modify it for your own system. It produces interesting and worthwhile documentation that may be useful if you have to modify a program in the future. ■

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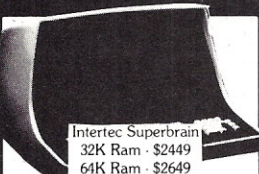


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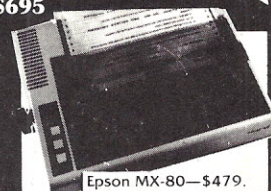
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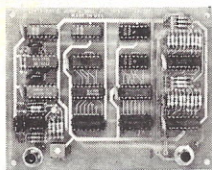


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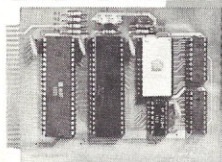


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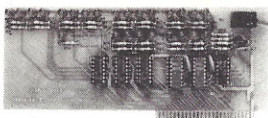
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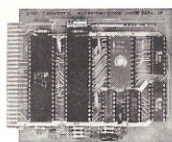
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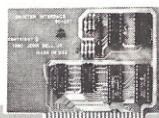


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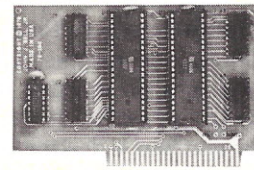
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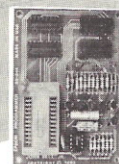
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# Apple Sector Counter Extraordinaire

By Craig Peterson

The message DISK FULL can be irritating to an Apple II owner when it flashes right in the middle of saving a long file of data or a long program. It would be nice to know how many free (unused) sectors are available. This short machine-language program, called Free Sectors, will provide you with this utility.

Inside Apple's disk operating system (DOS), there lives a friendly beast called VTOC (volume table of contents). Put simply, it contains in-

formation which tells the DOS what parts of the floppy disk already have information stored on them and what parts are available for use. Actually, the floppy disk stores this information in a special place, but the DOS reads it into a special VTOC save place (buffer) just about every time it does anything with the disk. VTOC tells how many free sectors you have.

## Operation

The operation of Free Sectors (FS)

consists of five main steps: save the 6502 registers, read the floppy disk's VTOC into the VTOC buffer in DOS, count the free sectors, print the free sectors message and restore the 6502 registers. The program uses some of the machine-language routines built into the Apple's monitor program, and also some that are part of the DOS. FS is assembled to run at location \$0300 (hexadecimal) to keep it out of the way of any other programs you might have in memory (see Listing 1).

Also, FS is set up to run on DOS version 3.2, 3.2.1, or newly released 3.3, and for a memory size of 48K RAM. If you have less than 48K, then the addresses for PRT#, RVTC and VPTR must be adjusted downward according to your memory size. For example, if you have 32K RAM, PRT# becomes hexadecimal \$6E46 (it was hexadecimal \$AE46). Similarly, the addresses for RVTC and VPTR become \$6FF7 and \$73F2, respectively.

Before you can use the program, you must load it into memory. If you don't have an assembler program to type the program into, the simplest method is to use the Apple's monitor program. From either BASIC, type CALL -151 to get into the monitor. Then enter the hexadecimal code of the program directly into memory at location \$0300 beginning with "48 98 48 8A . . ." etc.

After entering the program it's a good idea to check it by listing it in the monitor and comparing that listing with the original. If everything looks OK, BSAVE it to your disk using whatever name you desire. The starting address is \$0300 and length is

Listing 1. Free Sectors machine-language program for the Apple II.

```
0010 :*****
0020 :*
0030 :*      FREE SECTORS      *
0040 :*      BY                *
0050 :*      CRAIG PETERSON   *
0060 :*      OCTOBER 1980      *
0070 :*
0080 :* A PROGRAM TO COUNT THE FREE *
0090 :* (UNUSED) SECTORS AVAILABLE *
0100 :* ON AN APPLE II FLOPPY DISK *
0110 :*
0120 :*****
0130 :
0140 CNTR .DL 0044      SECTOR COUNTER
0150 PRT# .DL AE46      PRNT NUM IN $44
0160 RVTC .DL AFF7      READ VTOC SUBR
0170 VPTR .DL B3F2      VTOC POINTER
0180 CRTN .DL FD8E      PRINT CARIJ RTN
0190 COUT .DL FD8E      PRINT CHARACTER
0200 :
0210 :      .OR 0300      PROGRAM ORIGIN
0220 :
0230 STRT PHA          SAVE THE 6502
0240 TYA              REGISTERS
0250 PHA
0260 TXA
0270 PHA
0305 20F7AF          JSR RVTC      READ VTOC->BUFR
0308 A900            LDA 00        ZERO OUT THE
030A B544            STA *CNTR      SECTOR COUNTER
030C B545            STA *CNTR+01
030E A28C            LDX 8C        SET X INDEX
0310 A008            LUP1 LDY 08    SET Y = 8 BITS
0312 BDF2B3          LDA VPTR,X    GET VTOC BYTE
0315 0A             CBIT ASL        AND COUNT BITS
0316 9006            BCC SKIP
0318 E644            INC *CNTR
031A D002            BNE SKIP
031C E645            INC *CNTR+01
031F 88             SKIP DEY
0321 CA             DEX
```

More →

Address correspondence to Craig Peterson, 1743 Centinela, #102, Santa Monica, CA 90404.



\$62. Now you can quickly BLOAD it whenever you want to use it.

Using Free Sectors is simple. After loading it into memory, just insert the disk you're interested in and type CALL 768. The disk will begin spinning, and a message on the video screen will tell you the number of free sectors left on that disk. For another disk, insert the disk and type CALL 768 again. You can even use FS in Applesoft or Integer BASIC programs.

Free Sectors is a handy little utility. It probably should have been included as part of the disk operating system, but it wasn't.■

SYMBOL	TABLE
CNTR	0044
PRT#	AE46
RUTC	AFF7
VPTR	B3F2
CRIN	FD8E
COUT	FDED
STRT	0300
LUP1	0310
CBIT	0315
SKIP	031E
LUP2	0324
PRNT	0338
LUP3	0341
WRDS	0354
END	0362

Listing 1 continued.

```

0322 D0EC 0430 BNE LUP1
0324 A545 0440 LUP2 LDA *CNTR+01 PREPARE THE
0326 F010 0450 BEQ PRNT HUNDREDS PLACE
0328 38 0460 SEC IN THE X INDEX
0329 A544 0470 LDA *CNTR FOR PRINTING
032B E964 0480 SBC 64 LATER ON
032D B544 0490 STA *CNTR
032F A545 0500 LDA *CNTR+01
0331 E900 0510 SBC 00
0333 B545 0520 STA *CNTR+01
0335 E8 0530 INX
0336 10EC 0540 BPL LUP2
0338 208EFD 0550 PRNT JSR CRTN PRINT THE FREE
033B A002 0560 LDY 02 SECTOR COUNT
033D 8A 0570 TXA
033E 2046AE 0580 JSR PRT#
0341 C8 0590 LUP3 INY PRINT THE WORDS
0342 B95403 0600 LDA WRDS,Y 'FREE SECTORS'
0345 0980 0610 ORA 80
0347 20E1FD 0620 JSR COUT
034A C98D 0630 CMP 8D
034C D0F3 0640 BNE LUP3
034E 68 0650 PLA RESTORE 6502
034F AA 0660 TAX REGISTERS
0350 68 0670 PLA
0351 A8 0680 TAY
0352 68 0690 PLA
0353 60 0700 RTS
0710 ;
0354 204652 0720 WRDS .AS ' FREE SECTORS'
0357 454520
035A 534543
035D 544F52
0360 53
0361 8D 0730 .HS 8D
0740 ;
0750 END .EN

```

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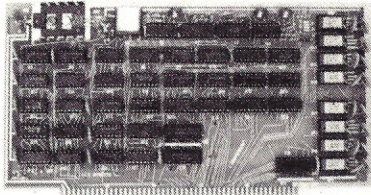
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# Building the H-89—Part 2

By Martin Moore

Software comes to the H-89 second-hand. That is, the H-89 was designed to operate with Heath's H8 software.

The H8 monitor (PAM/8) was originally written by the Wintek Corporation in 1976. In 1979 Heath updated the monitor for the H-89, keeping all the entry points and entry and exit conditions for PAM/8. In this way, software written for the H8 is directly transferable to the H-89. This is true for Extended Benton Harbor BASIC, EDIT, ASM and DBUG. All are modified versions of the Wintek H8 code. And, sadly, all are written mostly in 8080 language. Heath didn't take much advantage of the Z-80.

For \$30, you get a cassette and a reference manual. On the cassette are Benton Harbor Extended BASIC, TED-8 (editor), HASL-8 (assembler) and BUG-8 (debugger). For \$150, you get a disk and a reference manual. (See author's note.) The disk contains the same programs, with disk file-handling capabilities. The manuals are not for beginners. If you want tutorial information, you'll have to look elsewhere.

Both the cassette-based and disk-based programs have pretty much the same features. In the following text, I'll examine the common features of each, and discuss the particular differences between the tape and disk programs.

## The Operating Systems

If you were to get the H-88 (an H-89 without disk drive), you'd require the cassette-based software. There is no operating system, per se. If you want BASIC, you position your tape to the

BASIC file and use the monitor to LOAD the tape. Then you type GO.

The disk-based operating system, called HDOS, is flexible, and has been compared to CP/M (although the comparison might be stretching it a bit). In the next few paragraphs I'll discuss HDOS and its features.

**Bootup**—When you want to boot the H-89, you turn the machine on, insert a disk, and enter B on the terminal. The H-89 accesses the disk, then asks you to "Type SPACES to determine baud rate." This is done because HDOS will perform terminal I/O with whichever I/O port an ASCII space character comes from. In other words, if you wanted to use an auxiliary terminal, you could run the H-89 from that terminal by typing spaces at bootup.

Once you've established which terminal you're going to use, HDOS asks what you want to do: ACTION? <BOOT>. You can boot by entering a return, or you can ask the system to perform a checksum verification of all disk sectors by entering a C (for CHECK).

When you boot, HDOS tells you a number of things:

```
SYSTEM HAS 32K OF RAM
Volume 002, Mounted On SY0:
Label: PROGRAM DISK
HDOS Version 1.6
Issue #50.05.00
Date (DD-MMM-YY)?
```

As you can see, HDOS determines the amount of RAM installed in the H-89, gives you the volume number of the disk, as well as the drive (SY0:, SY1: or SY2:), and the disk label. Then the HDOS version and issue

numbers are given. If the boot was from a power-up, HDOS wants to know the date. If it was a reboot, HDOS prints the date and asks you to verify it.

**System Generation**—You receive HDOS on a distribution disk. The first thing to be done is copy the system files onto another disk. There are three steps to copying the distribution disk. The first is initialization. The second involves running diagnostics on the H-89 and disk drive.

The diagnostics perform several important tests:

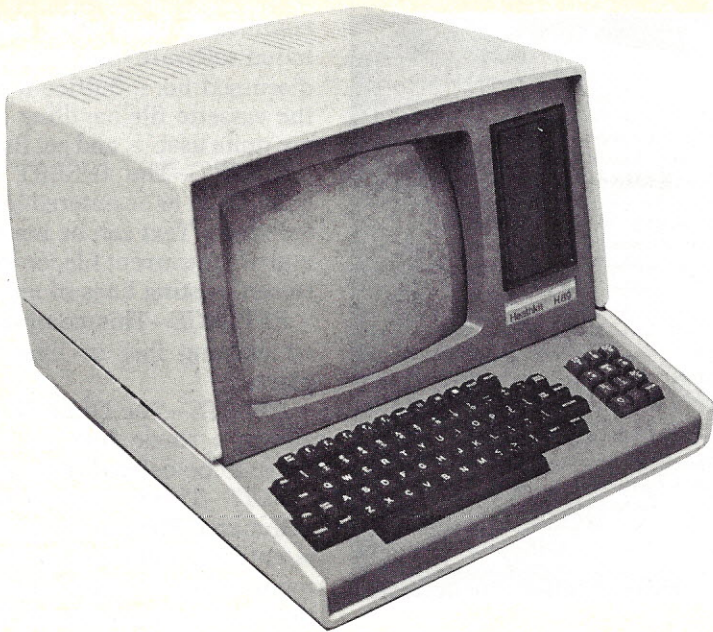
- a disk drive rotational speed test
- a general drive checkout
- a disk sector validity test
- a drive seek time test

The rotational speed test is the same one run when the H-89 is put together. It makes sure the disk rotates at the right speed. The general drive checkout is rather exhaustive, and takes over 30 minutes to run. It checks the capabilities of the drive to seek and read/write. The sector validity test checks each sector of the initialized disk and tells you how many bad sectors were discovered and which ones they are.

The drive seek time test is interesting and fairly valuable. Heath specifies that their drives will have 30 ms maximum track seek time. Heath also says that most drives will beat that time, and this test is used to find out just how fast the drive in the H-89 is. The test performs seek tests, starting at 30 ms, then works its way down in decrements of 2 ms, until it finds the

*Address correspondence to Martin Moore, 2735 S.W. 229, Aloha, OR 97006.*





The Heath H-89.

fastest reliable seek time. The best seek time for the drive in my unit turned out to be 10 ms. This number is important later on when the system is optimized.

Once you've run the diagnostics, you're ready to create a system disk. This is done with the SYSGEN command. All the files necessary for a minimum system are copied from the distribution disk to your new system disk.

If you want to copy BASIC, the assembler, editor or any of the other programs on the distribution disk, and you have only one drive, you'll have to use the ONECOPY program. ONECOPY is a utility that lets owners of systems with only one disk drive copy files from disk to disk.

**What's Available**—The distribution disk contains several files of use to the H-89 owner. Of course, BASIC, the assembler, the editor and the debugger are on the distribution disk and must be copied if you're going to use them. In addition, all the device driver programs (necessary to communicate to peripherals like printers and other terminals) are available to be copied. There's also a program called PATCH.ASM that's available, although SYSGEN doesn't copy it, and the Heath documentation doesn't say a thing about it. I assume it's used to upgrade software to newer versions.

## HDOS Files

HDOS will access a file from one of

three disk drives, called SY0:, SY1: and SY2:. Each file name can contain up to eight characters, as long as the characters are A through Z or 0 through 9. The file name can't begin with a number. In addition, each file name can have a three-character extension, such as .ASM or .BAS.

When files are called out in a command, they can be referenced to a specific drive (SY1:FILENAME.EXT, for example). If no drive reference is given, HDOS assumes you're talking about SY0:, the drive built into the H-89.

File manipulation might require that you specify a device in the command. Devices are those pieces of hardware that the file might be sent to or read from. For example, to copy a file to the terminal, you might enter the command TYPE FILENAME.EXT. HDOS would assume that the file was on SY0:. Or, you could enter COPY TT:=FILENAME.EXT. That would tell HDOS to copy the file to device TT:, which is the terminal. If you wanted to send a file from SY2: to the line printer, you would enter COPY LP:=SY2:FILENAME.EXT. Or, to copy a file from one drive to another, you would use COPY SY1:FILENAME.EXT=SY2:FILENAME.EXT. In this way, you can move a file almost anywhere. The recognized HDOS device names are:

SY0: Drive 0  
SY1: Drive 1  
SY2: Drive 2  
TT: The H-89 terminal  
AT: An alternate terminal

LP: The line printer

ND: The null device, used during troubleshooting, is not very useful during normal operations.

If you specify AT: or LP: in an HDOS command, you must have an appropriate program on the disk. AT: and LP: are actually device driver programs. The HDOS distribution disk contains several device driver programs that must be used to communicate with the outside world. For example, the HDOS distribution disk contains a program called LPH14.DVD. If you want to use Heath's H-14 line printer, you must transfer the file LPH14.DVD to your disk, and rename it LP.DVD. Then, when you enter a command like COPY LP:=FILENAME.DOC, HDOS uses LP.DVD to drive the printer port.

## HDOS Commands

There are 11 basic HDOS commands:

**CAT**—Short for Catalog, this command prints the disk directory. If you just enter CAT, the nonsystem file names are displayed on the terminal. If you enter CAT/S, all file names are displayed on the terminal. The directory listing shows the file name, extension, file size in sectors, date created or last updated and the flags. You can set the file flags to write-protect a file, suppress the file from being listed with just the CAT command or lock a file so that it can't be deleted. The CAT command can also be replaced by a DIR command. It does the same thing.

**RUN**—This command causes programs with the .ABS file name extension to be executed. For example, RUN EDIT causes the Heath editor to be run. You can just enter the file name, without entering RUN, and as long as the file exists with an .ABS extension, it will be executed.

**DATE**—This command lets you look at the date you entered when you booted up. The DATE command also lets you change the date.

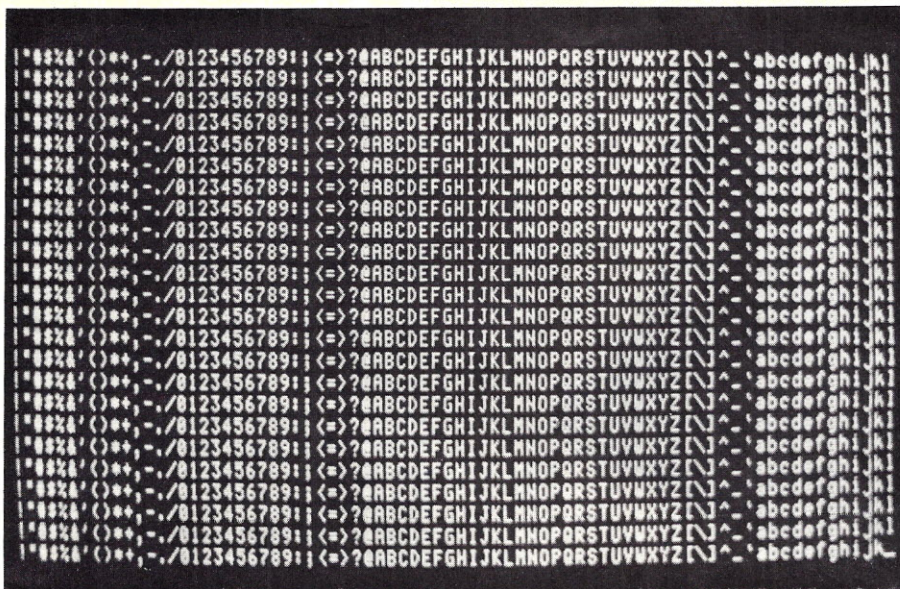
**COPY**—The COPY command is used to copy files to the terminal, to disk or to peripheral devices. The COPY syntax is:

COPY NEWFILE.EXT=OLDFILE.EXT

The COPY command is used to send files to peripherals by replacing the NEWFILE.EXT part of the command with a specific device driver, i.e., COPY DD:=FILENAME.EXT. DD: is my Diablo printer driver routine.

**TYPE**—This command types files to the terminal.





A portion of the H-89 character set. The distortion on the sides is due to photographer error, and is not apparent on the screen.

**RENAME**—The RENAME command does just what its name implies. It's used to rename files.

**DELETE**—The DELETE command also does what its name implies. DELETE can be used to delete several files at once by separating file names with commas; i.e., DELETE FILE1.EXT, FILE2.EXT, etc.

**MOUNT**—The MOUNT command is used to mount disks on drives.

**DISMOUNT**—The DISMOUNT command allows you to dismount disks in an orderly fashion.

**VER**—This command gives you the version of HDOS you're running.

**BYE**—The BYE command allows an orderly dismount of the system disk and asks for a new system disk to reboot.

**STAT**—The H-89 keeps track of the number of disk reads and writes you do during a session. When you enter the STAT command, HDOS tells you the number of reads and writes, as well as the number of soft (recoverable) and hard (nonrecoverable) errors. HDOS specifies that a hard error is an error that has recurred ten times during the same type of operation on the same disk.

All of these commands run under another program called PIP (Peripheral Interchange Program), the program that actually executes all the other HDOS commands. You can call up PIP simply by entering PIP. The commands used by PIP are much abbreviated, but perform the same actions as the "higher-order" HDOS commands.

That's HDOS. Now, let's look at

the other programs you get with the HDOS disk.

## EDIT

Let's start with the text editor, called EDIT by HDOS and TED-8 by the cassette-based software. EDIT is a rather primitive line editor, with some limitations and some good points. By the way, there are some peculiar differences between cassette-based TED-8 and disk-based EDIT. In the following discussions of EDIT, some commands will be noted to be available in cassette software only. Heath's reason behind this is unknown to me.

EDIT is a line-oriented editor. It's always aware of the top and bottom of the text currently in the buffer. Therefore, all commands are in reference to either the top or bottom of text. For example:

→↑+5,\$4DELETEB

means "starting with the sixth line from the top (indicated by the up-arrow and +5), to, but not including, the bottom four lines (indicated by the \$-4), delete all text." The "B" at the end of the command string means display the lines before they're deleted.

This is the reason I said that EDIT is a rather primitive editor. To use the type of command string shown, you have to know where you are and where you're going at all times. This type of command entry requires some care, and is difficult, but not impossible, to use.

Following are the EDIT commands. There are some file-handling

commands used with the cassette-based software, but those will not be discussed here. Suffice it to say that the cassette file-handling commands are quite usable, and get the job done.

**INSERT**—The INSERT command allows text to be entered into the buffer space. Text can be inserted at the end of the current file, or inserted between existing lines of text.

**REPLACE**—This command allows an existing line or lines to be replaced.

**DELETE**—The DELETE command allows a single line, or a series of lines, to be deleted from the buffer.

**EDIT**—This is a search and replace command. The text string to be found is entered, followed by the replacement string. A single word or an entire line may be replaced. You can also specify how many occurrences of the string are to be replaced.

**PRINT**—This command is used to print a number of lines on the terminal. The number of lines can be qualified. Cassette software also uses this command to output text on a line printer, and to set the size of the pages printed.

**TAB (cassette only)**—The TAB command allows you to set tab stops in the text. Disk-based software doesn't support this command.

**BLITZ**—This command destroys all the text in the buffer. If you enter BLITZ, the H-89 comes back to ask if you're sure you want to do that.

**SEARCH**—The SEARCH command is used to search for a character string. If cassette-based software is used, SEARCH will also search through other files for the string.

**NEWIN (disk only)**—The NEWIN command prepares EDIT to read a new input file. The file name is given inside double quotes: NEWIN"filename.doc".

**READ (disk only)**—The READ command is used to read the disk file into the buffer.

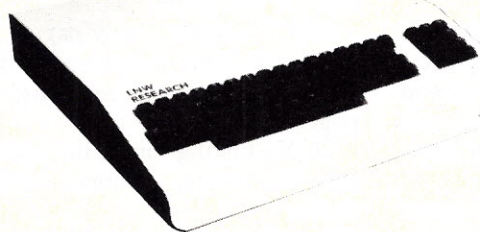
**NEWOUT (disk only)**—The NEWOUT command prepares the disk to accept the text from the buffer. It must be followed by the file name: NEWOUT"filename.doc".

**BYE**—The BYE command writes the current buffer out to the disk, and then exits from EDIT.

One of the major problems with the disk-based editor is its lack of concern for the user. Let's take the following situation, for example. Suppose you have a file on disk that uses 30 sectors. There are currently 28 free sectors remaining on the disk.



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If you pull the file into the editor, add one word, and then try to replace the file, EDIT will give you an error message and a terrible headache. You get the headache because EDIT requires a reserve of disk space equal to the size of the file you're trying to store. In other words, you can't replace (replace, not create) a 30-sector file if you have only 28 unused sectors. And, the worst of it is that after you attempt such a thing, it's more than likely that you'll lose any changes you made to the file because it will no longer exist in the buffer.

## ASM

The Heath assembler (called ASM by HDOS, and HASL-8 by the cassette software) is a pretty good assembler. ASM has a good deal of flexibility and a lot of useful features. But—and this is the big one, folks—ASM will not assemble Z-80 code! It's incredible but true. You would think that Heath went to the Z-80 because of that microprocessor's expanded instruction set. If it were just 2 MHz operation they were after, they could have stuck with the 8080. But, there it is. An 8080 assembler. Ah, well.

The Heath Users' Group (HUG) does sell a Z-80 assembler for the H-89, however. So all is not lost.

ASM is a two-pass assembler, and will work with decimal, octal, split octal, hexadecimal or binary numbering systems. ASM recognizes five operators: +, -, \*, / and - (unary negation).

Let's talk about the strength of any assembler, the pseudo-ops.

The ASM assembler supports 20 pseudo-ops, or directives. They are:

**DB**—Define byte. This pseudo-op defines byte contents. The bytes can be defined as integers, labels or character strings.

**DW**—Define word. The DW pseudo-op defines 16-bit word constants.

**DS**—Define space. This pseudo-op reserves a block of memory for use by a labeled symbol. For example, "BUFF DS 80" reserves 80 bytes of memory for BUFF.

**IF/ELSE**—The IF and ELSE directives are conditional assembly directives. The IF pseudo-op will conditionally prevent assembly of the lines following IF, so long as the argument after the IF directive is false. IF is used very much like it is in BASIC. ELSE turns assembly back on. In other words, if line 20 of your source code contained an IF directive, and the argument was false, no more code would be assembled until ASM found the ELSE statement.

**ENDIF**—The ENENDIF pseudo-op means "don't assemble any more lines if the argument following END-IF is false."

**END**—This pseudo-op marks the end of the program.

**EQU**—Equate. The EQU pseudo-op assigns an arbitrary value to a symbol in the label field.

**SET**—This pseudo-op, like EQU, assigns an arbitrary value to a symbol in the label field. Unlike EQU, however, the label defined by SET can be redefined later in the program.

**ORG**—Origin. The ORG statement sets the initial value of the memory location counter.

**ERRxx**—There are four conditional error pseudo-ops. They are:

- **ERRZR**—tests for a zero expression
- **ERRNZ**—tests for a non-zero expression
- **ERRPL**—tests for a positive expression
- **ERRMI**—tests for a negative expression

When the assembler encounters one of these error statements, it checks the expression following the state-

ment. If the expression is true, nothing happens. If the expression is false, an error code is flagged in the assembly listing.

The following pseudo-ops control the way the assembler listing is printed out.

**TITLE**—The TITLE statement lets you create a new page title.

**STL**—Subtitle. This sets a new subtitle for the page.

**EJECT**—Starts a new page.

**SPACE**—This statement is used to set the top and bottom margins of a page.

**LON**—Listing on. This statement sets the listing options, which include:

- list all program lines
- list only lines containing errors
- list the lines skipped by the IF pseudo-op
- list all generated bytes

**LOF**—Listing off. This statement disables all the LON options.

These assembler commands are available in both ASM and HASL-8.

The disk-based ASM has a special command called XTEXT, which lets the assembly-language programmer make use of some of the HDOS functions by allowing "system calls" to HDOS software. For example, there is an HDOS routine that reads characters from the terminal. That routine (called .SCIN) can be called by your assembly-language program if you enter "SCALL .SCIN" at the point that you want to read a terminal character.

One further requirement is that you tell ASM that you're going to require the services of system calls by placing the XTEXT command at the beginning of your program. The XTEXT command is followed by the name of a file with an .ACM (assembler common) extension. Heath provides a file called HDOS.ACM that's used with XTEXT. The HDOS.ACM file contains a few basic system call pointers. If you want to access disk files with an assembly-language program, you have to write Heath and ask for a manual called the *HDOS System Programmer's Guide*. The manual is free of charge and contains the system calls that are used to access disk files.

## DBUG

The Heath Console Debugger (DBUG for the disk-based system, and BUG-8 for the cassette-based system) is a pretty handy tool for sorting out those errors that were left in your

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program following assembly. The debugger allows you to:

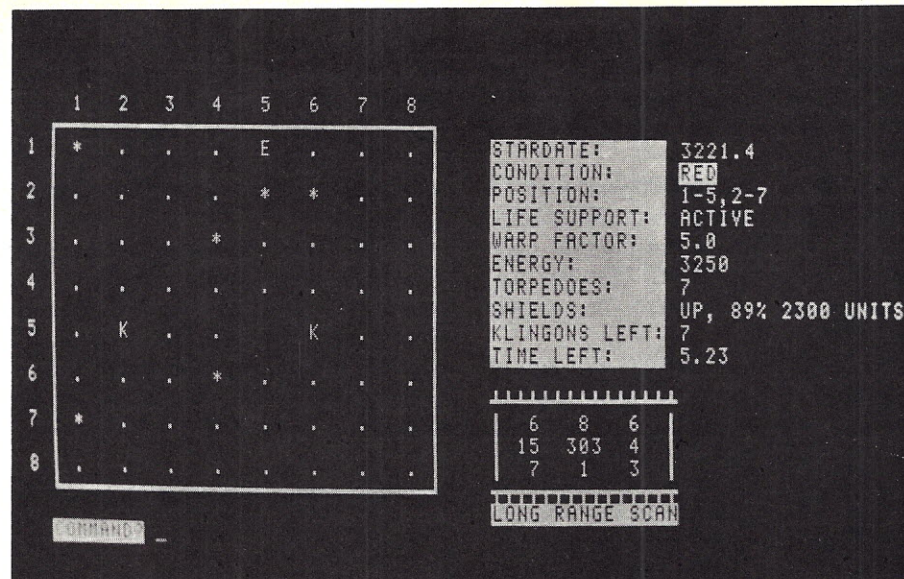
- load a program from tape or disk
- look at and change memory contents
- look at and change the 8080 equivalents of Z-80 registers
- set breakpoints in the program
- single-step program execution
- execute the program
- dump the modified program back onto tape or disk

Ignoring the program load and dump, let's look at what you can do with DBUG.

Firstly, you can look at and alter memory using either octal, decimal or ASCII notation. The notation selection is done with the first field of a memory command. Secondly, you can specify a range to be displayed or altered by entering a character in the second field of the command. For example:

:B:D1200-1205 331 201 009 131 167 309

In the command listed, :B: is the prompt character. The D tells DBUG to display the memory contents in decimal notation, byte format. And the 1200-1205 gives a memory range. The six values following the com-



A familiar display, using the H-89 graphics characters and reverse video. The H-89's addressable cursor allows you to update a display like this without rewriting the entire screen.

mand and range are the contents of memory, listed in decimal notation. If you changed the D to an F, the memory contents would have been listed in octal notation, word format.

Memory can be displayed in a variety of ways, and in a variety of

ranges. For example, if the 1200-1205 had been replaced with /25, the 25 addresses following the last address of the previously specified range would have been displayed. Lots of flexibility here.

Memory is altered with an = sign.

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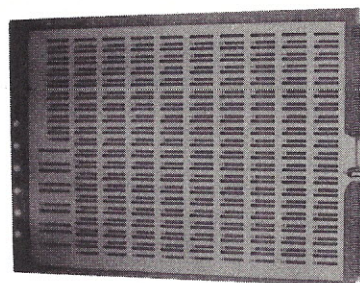
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If you enter an address followed by an = sign, DEBUG will display the contents of that address followed by a slash. Then you can place a new value into memory. For example:

:B: 60000=000/101

In this example, 60000 was entered as the address of concern. DEBUG displayed the 000/ as the current contents of address 60000. The 101 following is the new value to be entered into 60000.

As I said before, DEBUG is a handy tool. But, you can't look at or alter all the Z-80 registers. You can only look at the 8080-type registers. Again, what a pity that Heath didn't make full use of the Z-80. And did you notice I didn't mention hexadecimal displays? Sorry, but DEBUG doesn't do hex.

### Extended Benton Harbor BASIC

What can I say about Benton Harbor BASIC? It's like a lot of other medium-quality BASICs. It will handle numeric and string data, Boolean values, variables and subscripted variables, expressions, your normal arithmetic operators, relational operators, Boolean operators and so on.

This BASIC has two modes of operation: command mode and program mode. In some cases, these two modes can be mixed, as we'll see later.

Command mode statements are statements you can use without assigning them a program line number. The command mode statements are:

**BUILD**—This statement is used to build a program. Some other BASICs refer to this as auto number. The BUILD statement automatically supplies the next line number each time you hit return. For example, "BUILD 50,10" means "starting at line 50, automatically create new lines in increments of 10 each time a return is entered."

**DELETE**—This statement lets you delete a single program line, or a range of lines. For example, "DELETE 170,250" deletes lines 170 through 250.

**SCRATCH**—SCRATCH is a little more violent than DELETE, in that it destroys the entire program. When you enter SCRATCH, BASIC comes back and asks if you're sure you want to do that.

**CONTINUE**—This is an interesting statement. If your program contains a STOP statement, the H-89 will, of course, stop. But you can continue past the STOP statement by entering

CONTINUE. This is great for debugging programs. Liberally sprinkle STOPs throughout the program, and Extended Benton Harbor BASIC will let you regain control, take a look at your variables and continue on your merry way, without starting all over again.

**LOCK**—The LOCK statement keeps you from accidentally changing or running a program you've loaded from disk or tape. LOCK prevents execution of all the command mode statements we've discussed up to now, plus some of the file-handling

```

10 CNTRL 0,100
20 FOR I = 1 TO 7
30 PRINT "X","X","X","X"
40 NEXT I
50 END
100 PRINT "WOOPS!"
110 RETURN

* RUN

X      X      X      X
X      X      X      X (<CNTRL> B TYPED)

WOOPS!
X      X      X      X
X      X      X      X
X      X      X      X
X      X      X      X (<CNTRL> B TYPED)

WOOPS!
X      X      X      X

END AT LINE 50

```

Listing 1. CNTRL 0 statement.

statements. LOCK is implemented automatically each time a program is loaded.

**UNLOCK**—What you have to do to run a locked program.

There is a second set of statements that falls between command mode statements and program statements. These statements can be used within a program, or they can be used outside the program. For example, when in the command mode, you can enter the following statements:

\*Print "Hello There"

\*Hello There

\*

or

\*FOR I = 1 TO 3:PRINT "Hello There!";NEXT I

\*Hello There! Hello There! Hello There!

\*

As you can see, there's no line number. As soon as BASIC is loaded and running, you can enter a variety of commands without actually creating a line-numbered program.

The second half of the example shows another feature of Extended Benton Harbor BASIC. You can enter multiple statements on a line, as long as they're separated by a colon. In this particular mode, you can only

enter as many statements as will fit on a single line. Statements requiring more than one line must be placed into a line-numbered program.

Let's look at the statements you can use in this way. Remember, all of these statements can be used in a program, or outside a program.

**CLEAR**—The CLEAR statement will clear the contents of a single variable, or the contents of all variables, arrays, string buffers and stacks.

**CNTRL**—The CNTRL statement is a multifunction command. There are five CNTRL options:

●**CNTRL 0**. This option points to a subroutine that will be executed every time <CNTRL> B is entered on the terminal. Each time <CNTRL> B is entered, the executing program is interrupted, and control is passed to a subroutine pointed to by the CNTRL 0 statement. An example of the CNTRL 0 statement is shown in Listing 1. The subroutine at line 100 could be whatever you wanted it to be.

●**CNTRL 1**. The CNTRL 1,n command sets the number of digits permitted before exponential notation is used. The value of n is from one to six digits.

●**CNTRL 2**. This command is a holdover from the H8, and is used to control the H8 front panel LED display. It serves no useful purpose in the H-89.

●**CNTRL 3**. The CNTRL 3 statement controls the size of the print zones used in a PRINT statement.

●**CNTRL 4**. This command turns the 2 ms clock within the H-89 off and on. The clock is used in clock-dependent functions such as PAUSE and PAD.

**DIM**—This statement is used just like it would be in a normal program—it dimensions variables. DIM is one of those statements you can use to change variable sizes after your program has stopped. You can put a STOP in the program, and once the program has ceased execution, go in and alter the variable, and then CONTINUE.

**FOR/NEXT**—The FOR and NEXT statements are used in exactly the same manner as shown in the first example.

**GOSUB**—You can enter a GOSUB statement in the command mode, and follow it with the CONTINUE statement, and program execution will begin where you told it to.

**GOTO**—The GOTO statement works in the same way as the GO-

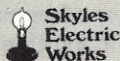


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SUB statement.

**IF/THEN**—These statements are used just as they are in the program. If a variable you enter in command mode is true, then the statement following the THEN will be executed.

**LET**—The LET statement also works just as it does in a program.

**LIST**—List one line, a range of lines or the entire program.

**ON GOSUB**—This statement works exactly the same as it would if it were in a program.

**ON GOTO**—Again, this statement works exactly the same as it would if it were in a program.

**OUT**—This statement sends a binary number to an output port specified in the command.

**PAUSE**—This is another interesting command. PAUSE will let you delay execution of the program. For example, if you just enter PAUSE, either in the program or in command mode, program execution will stop until you hit another key. If you enter PAUSE followed by an integer, program execution will be paused two times the integer (in ms).

**POKE**—This statement pokes a decimal number into a selected mem-

ory address.

**PEEK**—The PEEK statement lets you look at the contents of a selected memory location.

**PORT**—The PORT statement assigns control functions away from the original console. In other words, you could connect another terminal to the H-89 and direct BASIC to talk to that terminal instead of the built-in terminal.

**PRINT**—This statement is used just as it is in a program.

**READ**—The READ statement can be used in the command mode, although it is of limited value because the DATA statement has to follow on the same line.

**REM**—Again, this statement is of little value in the command mode, but it's available.

**RESTORE**—The RESTORE statement moves the data pointer back to the beginning of a DATA list.

**STEP**—The STEP statement is the single-step command. You can tell BASIC to execute n number of lines and then halt and wait for another STEP command. Very handy for troubleshooting your program.

**FREE**—This statement tells you the

condition of your program and memory. FREE gives you the following information:

- bytes used by the program text
- bytes used by variables and arrays
- bytes used by FOR loops
- bytes used by GOSUBs
- bytes used by expression and function evaluation
- bytes used by STRINGs
- total number of free memory bytes remaining

All of these statements can be entered on the terminal without a line number. They're executed as soon as the return is entered.

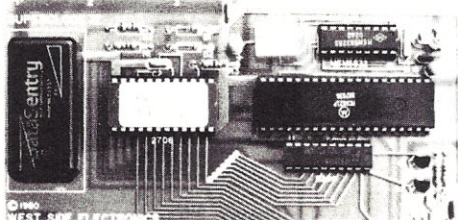
### Program Mode Functions

There are only a few remaining statements that cannot be entered except in a program. They include DEF FN, END, INPUT, LINE INPUT and STOP. A complete list of statements, as well as the predefined functions used in Extended Benton Harbor BASIC, is shown in Table 1.

There is a peculiar difference between disk BASIC and cassette BASIC. Cassette BASIC has a "command completion" feature. That is, you only have to type in the first few

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letters of a command, and cassette BASIC will fill in the rest of the command. For some strange reason, disk BASIC doesn't have that feature.

Another thing that's missing from the BASIC package is a built-in renumbering routine. You can't renumber a program unless you write a renumbering program yourself... or buy one from somebody.

As you can see, Extended Benton Harbor BASIC is complete. You can do most anything you want. It doesn't, however, strike me as being particularly fast. The North Star Horizon BASIC has about ten times the execution speed. But, the H-89 is about on par with Radio Shack's TRS-80 Model I.

## Software Support

Heath has been accused of not pro-

viding a great deal of software for its machines. And, it's true that there aren't nearly as many people developing software for the H-89 as there are for the TRS-80. But software is available.

One source of software is the Heath User's Group. The group has a software library of over 500 programs for the H8, H11 and H-89. For more information, you can write to the Heath Users' Group, Hilltop Road, Saint Joseph, MI 49085.

Then there's BUSS: The Independent Newsletter of Heath Co. Computers. The people at BUSS provide a monthly newsletter concerning the activities of Heath and the users of Heath equipment. As far as early information is concerned, the BUSS folks seem to have a pipeline directly to the Heath Company. You can get more information from BUSS, 325 Pennsylvania Ave. S.E., Washington, DC 20003.

Lifeboat Associates is offering a Heath CP/M operating system for the H-89. Their asking price is \$145. The CP/M package includes a text editor, assembler, debugger and other utilities, and you get six user's manuals.

Lifeboat Associates says that most programs designed to run under CP/M will work with this version, including MicroSoft BASIC, FORTRAN and COBOL.

Heath itself is expanding its software line somewhat. Heath offers MicroSoft BASIC, MicroSoft FORTRAN and the Zenith Electronic Typing word processor. Heath also offers and supports version 2.2 of CP/M on the H-89. Heath plans to offer an eight-inch floppy disk system (double-sided, double-density, IBM-compatible), too.

*Author's note:* New additions to the Heath line of software include 0-based CP/M and a new version of HDOS.

## Conclusions

I hope I haven't sounded too disparaging about the H-89. I like it. And, I hope this has given you a better look at the H-89. This is a powerful computer, with a lot of software backing it up. If your requirements for a computer are the same as mine were, I'd recommend the H-89 highly. I'm pleased, and I think you would be too. ■

BUILD	BYE
CONTINUE	DELETE
LIST	OLD
REPLACE	RUN
SAVE	SCRATCH
CHAIN	CLEAR
CLOSE	CONTROL
DIMENSION	FOR/NEXT
FREE	FREEZE
GOSUB	RETURN
GOTO	IF/THEN
LET	LOCK
ON/GOSUB	ON/GOTO
OPEN	OUT
PAUSE	POKE
PRINT	READ/DATA
REMARK	RESTORE
STEP	UNFREEZE
UNLOCK	UNSAVE
DEF FN	END
INPUT	LINE INPUT
STOP	

ABS	ASC
ATN	CHR\$
CIN	COS
EXP	INT
LEFT	LEN
LNO	LOG
MATCH	MAX
MID\$	MIN
PAD	PEEK
PIN	POS
RND	RIGHT\$
SEG	SGN
SIN	SPC
SQR	STR\$
TAB	TAN
VAL	

Table 1. Statements that cannot be entered except in a program and predefined functions used in B. H. BASIC.



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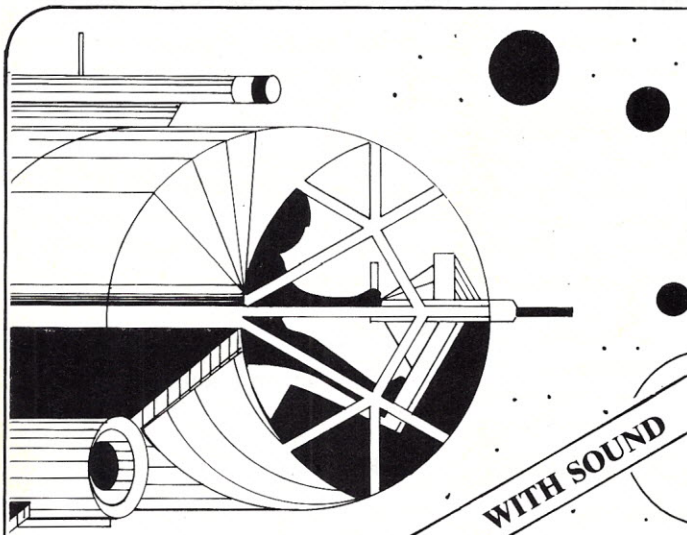
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1.3 In addition, alien ships can make in-

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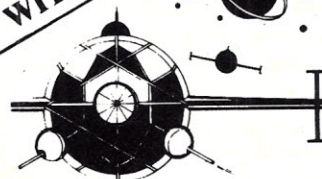
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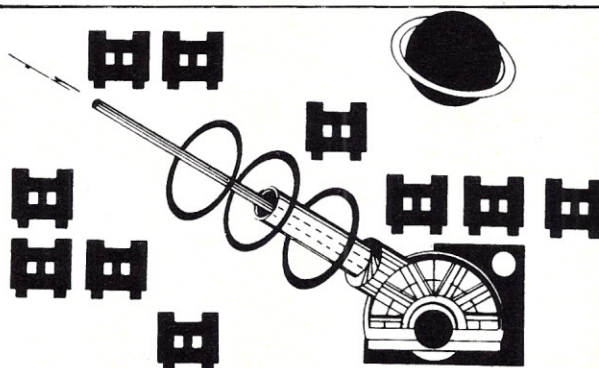
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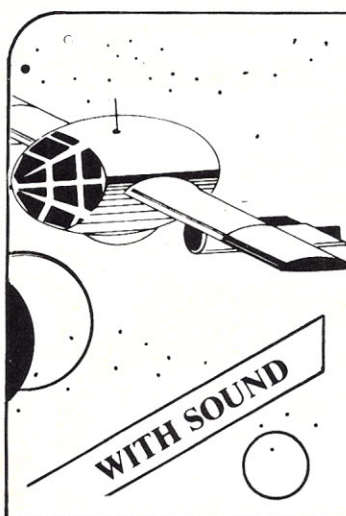
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# Math Can Be Fun

By Richard R. Parry

*Sample run.*

```

RUN
HI! MY NAME IS PAL, WHAT'S YOURS? JENNIFER
OK JENNIFER, LETS PLAY A NUMBERS GAME
WOULD YOU LIKE INSTRUCTIONS (YES OR NO) ? YES
I WILL GIVE YOU ADDITION, SUBTRACTION, MULTIPLICATION,
OR DIVISION PROBLEMS. A LITTLE BIT OF EACH IF YOU LIKE
SIMPLY
TYPE 1 FOR ADDITION
TYPE 2 FOR SUBTRACTION
TYPE 3 FOR MULTIPLICATION
TYPE 4 FOR DIVISION
TYPE 5 FOR A LITTLE OF EACH
WHEN YOU ARE DONE PLAYING, TYPE 999 WHEN I
GIVE YOU A PROBLEM AND I WILL GIVE YOU YOUR SCORE
DON'T FORGET TO DEPRESS THE 'RETURN' KEY AFTER EVERY ENTRY
WHAT IS YOUR PLEASURE (1,2,3,4 OR 5)? 5
WHAT MAXIMUM VALUE SHOULD I GIVE FOR ONE NUMBER ? 12
WHAT MAXIMUM VALUE SHOULD I GIVE YOU FOR THE OTHER NUMBER ? 24
HIT ANY KEY? P

1 . 11 X0 =? 0
CONGRATULATIONS
2 . 0 X12 =? 12
SORRY, TRY AGAIN JENNIFER
2 . 0 X12 =? 0
NICE GOING JENNIFER
3 . 2 X2 =? 4
VERY GOOD JENNIFER
4 . 0 X3 =? 0
CONGRATULATIONS
5 . 3 +4 =? 7
NICE GOING JENNIFER
6 . 12 -9 =? 3
CONGRATULATIONS
7 . 6 /6 =? 1
NICE GOING JENNIFER
8 . 10 X5 =? 55
I KNOW YOU CAN DO BETTER THAN THAT
8 . 10 X5 =? 15
SORRY, TRY AGAIN JENNIFER
8 . 10 X5 =? 50
NICE GOING JENNIFER
9 . 40 /5 =? 9
I KNOW YOU CAN DO BETTER THAN THAT
9 . 40 /5 =? 8
NICE GOING JENNIFER
10 . 4 X6 =? 24
NICE GOING JENNIFER
11 . 8 +7 =? 999
HOPE TO SEE YOU AGAIN JENNIFER
```

More

Teaching machines have been around for a long time. Their advantages are well known to educators. With the proper software, any microcomputer can be transformed into a teaching machine. Programs have been written to teach many subjects, even a computer language. The software described in this article is aimed at teaching young students the four basic arithmetic functions: addition, subtraction, multiplication and division.

## Program Requirements

There are several features that should be incorporated into a teaching machine for it to be efficient and effective. Of utmost importance is the need to keep the student actively involved and interested. Little, if any, learning will take place if the student is ambivalent.

The interactive nature of BASIC provides the involvement, and the novelty of communicating with a computer and receiving feedback provides the necessary interest. In addition, interest is enhanced by the personal nature of the messages that are communicated to the student by the computer. The responses use the student's name, which helps create a friendly environment conducive to learning.

A good teaching machine should immediately and positively reward the student for a correct answer. Re-

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sponses such as "Nice going" or "Congratulations" go a long way in encouraging the child. If an incorrect answer is given, the machine should provide neutral feedback in order not to offend or discourage the student. Responses such as "Sorry, try again" and "I know you can do better than that" encourage the student to continue.

When an incorrect answer is given, the machine gives an appropriate response and then gives the student the opportunity to try the problem again. In this Math Teacher program, there are six possible responses: three to indicate a correct response and three for an incorrect response.

A teaching machine should also be easy to use. For this reason, the program starts by asking if the student would like instructions. If so, the necessary instructions to use the teaching machine are displayed.

It is also important that the student be able to alter the complexity of the problems by allowing the student to insert the maximum value that should be given for each of the two numbers that are used in formulating the problem.

The machine should also provide variety by allowing the student to select either addition, subtraction, multiplication or division problems. A random sampling of each of these categories is also possible. Because of this flexibility, you can use the program for several grade levels. For example, addition is typically taught in first grade, subtraction in second, multiplication in third and division in fourth.

Finally, the machine should indicate the progress of the student. This provides additional feedback (hopefully, it is positive feedback). When the student is finished answering questions, he types 999. The machine then displays the total number of different problems answered, the number of correct and incorrect answers and the percentage correct.

The program listing shown was written in SWTP BASIC, Version 2.0. Few, if any, instructions are unique to this version; it should, therefore, run on any BASIC machine with little or no modification. The program is not particularly complex and can be easily modified if necessary. Several REM lines are given throughout the program to aid in understanding the program. ■

*Sample run continued.*

```
TOTAL NUMBER OF PROBLEMS 10
TOTAL NUMBER CORRECT 7
TOTAL NUMBER WRONG 3
PERCENTAGE CORRECT 70 %
```

```
READY
#
```

*Program listing. Arithmetic program in SWTP BASIC.*

```
0100 LINE= 80
0110 X=RND(1)
0120 PRINT "HI! MY NAME IS PAL, WHAT'S YOURS";
0130 INPUT N$
0140 PRINT "OK "; N$; ", LETS PLAY A NUMBERS GAME"
0142 PRINT "WOULD YOU LIKE INSTRUCTIONS (YES OR NO) ";
0143 INPUT Y$
0144 IF LEFT$(Y$,1)="N" THEN 230
0150 PRINT "I WILL GIVE YOU ADDITION, SUBTRACTION, MULTIPLICATION,"
0160 PRINT "OR DIVISION PROBLEMS. A LITTLE BIT OF EACH IF YOU LIKE"
0170 PRINT "SIMPLY"
0180 PRINT "TYPE 1 FOR ADDITION"
0190 PRINT "TYPE 2 FOR SUBTRACTION"
0200 PRINT "TYPE 3 FOR MULTIPLICATION"
0210 PRINT "TYPE 4 FOR DIVISION"
0220 PRINT "TYPE 5 FOR A LITTLE OF EACH"
0222 PRINT "WHEN YOU ARE DONE PLAYING, TYPE 999 WHEN I"
0223 PRINT "GIVE YOU A PROBLEM AND I WILL GIVE YOU YOUR SCORE"
0224 PRINT "DON'T FORGET TO DEPRESS THE 'RETURN' KEY AFTER EVERY ENTRY"
0230 PRINT "WHAT IS YOUR PLEASURE (1,2,3,4 OR 5)";
0240 INPUT T
0250 PRINT "WHAT MAXIMUM VALUE SHOULD I GIVE FOR ONE NUMBER ";
0260 INPUT N
0270 PRINT "WHAT MAXIMUM VALUE SHOULD I GIVE YOU FOR THE OTHER NUMBER ";
0280 INPUT P
0290 PRINT "HIT ANY KEY";
0291 INPUT R$
0292 FOR I=1 TO ASC(R$)
0293 R1=RND(0)
0294 NEXT I

0300 IF T < 5 THEN 330
0310 LET G = 1
0320 LET T=INT(4*RND(0)+1)
0330 LET A = A + 1
0340 LET X = INT((N+1)*RND(0))
0350 LET Y = INT((P+1)*RND(0))
0360 ON T GO TO 380,420,500,540
0370 REM ***** ADDITION *****
0380 LET Z1 = X + Y
0390 PRINT A$ ". "; X; "+"; Y; "=";

0401 GOTO 610
0410 REM ***** SUBTRACTION *****
0420 IF X > Y THEN 460
0430 LET X1 = Y
0440 LET Y = X
0450 LET X=X1
0460 LET Z1 = X - Y
0470 PRINT A$ ". "; X; "-"; Y; "=";
0480 GOTO 610
0490 REM ***** MULTIPLICATION *****
0500 LET Z1 = X * Y
0510 PRINT A$ ". "; X; "X"; Y; "=";
0520 GOTO 610
0530 REM ***** DIVISION *****
0540 IF X > 0 THEN 570
0550 LET X = Y
0560 LET Y = 0
0570 LET L = X * Y
0580 LET Z1 = Y
0590 PRINT A$ ". "; L; "/" ; X; "=";

0600 REM ***** INPUT THE ANSWER PORTION OF THE PROGRAM *****
0610 INPUT Z
0620 IF Z = 999 THEN 790
0630 IF Z = Z1 THEN 700
```

*More* →



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Program continued.

```

0640 R3=RND(0)
0642 IF R3 > .333 THEN 668
0650 PRINT "SORRY, TRY AGAIN ";N$
0660 GOTO 680
0668 IF R3 > .667 THEN 674
0670 PRINT "I KNOW YOU CAN DO BETTER THAN THAT"
0672 GOTO 680
0674 PRINT "CONCENTRATE ";N$
0680 LET F = 1
0690 ON T GO TO 390,470,510,590
0700 R2=RND(0)
0701 IF R2 > .333 THEN 728
0710 PRINT "CONGRATULATIONS"
0720 GOTO 740
0728 IF R2 > .667 THEN 734
0730 PRINT "VERY GOOD ";N$
0732 GOTO 740
0734 PRINT "NICE GOING ";N$
0740 IF F = 1 THEN 760
0750 LET B = B + 1
0760 LET F = 0
0770 IF G = 1 THEN 320
0780 GOTO 330
0790 PRINT "HOPE TO SEE YOU AGAIN ";N$
0800 LET A = A - 1
0810 LET C = A - B
0820 LET D = 100 * B/A
0830 PRINT
0840 PRINT
0850 PRINT "TOTAL NUMBER OF PROBLEMS ";A
0860 PRINT "TOTAL NUMBER CORRECT ";B
0870 PRINT "TOTAL NUMBER WRONG ";C
0880 PRINT "PERCENTAGE CORRECT ";D;"%"
0890 END
    
```



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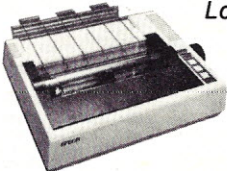


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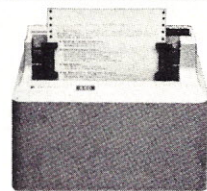


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# SIRIUS 8000 and 80 + HIGH PERFORMANCE, LOW COST FLOPPY ADD-ONS!

The SIRIUS SYSTEMS 8000 and 80 + Series of Floppy Disk Add-Ons are designed to provide unmatched versatility and performance for your TRS-80\* MOD I and MOD II.

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■ SINGLE/DOUBLE Density Operation  
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■ Exceptional Speed Stability ■ 5ms track-to-track access time (25ms for the 80 + 5) ■ Switch Selectable Drive Address

The SIRIUS 80 + 5 is a SINGLE SIDED, 40 TRACK Disk Drive with 102K/204K Bytes Single/Double Density Operation. **SPECIAL INTRODUCTORY PRICE!!!**

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(with Floppy-Disk Option).....\$314.95  
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SIRIUS 80 + 2—a DOUBLE SIDED, 80 TRACK (40/side) Disk Drive. It appears to the TRS-80\* as TWO 40 TRACK drives yet COST LESS THAN HALF THE PRICE! This unit may require the SS Standard Cable. Formatted data storage is 204K/408K Bytes Single/Double Density.

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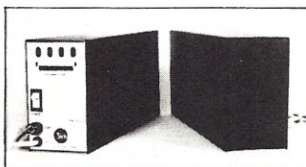
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**SIRIUS 80 + 4.....\$629.95**

Note: The Expansion Interface limits drives to 12ms track-to-track

\*TRS-80 of Tandy Corp.

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SS Standard 2 Drive Cable.....\$29.95

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Apparat.....\$139.95

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## Introducing the Versatile, Low-Cost OMEGA Series Controller

As new technological advances bring down the cost of fast, reliable mass data storage, the need for an inexpensive, versatile controller have become greater and greater. To meet this need, SIRIUS SYSTEMS' OMEGA Series Controller was designed.

The SIRIUS OMEGA Series Controller Module utilizes an on-board microprocessor to mediate data transfer to a wide variety of peripherals from an equally wide variety of host computer systems. Up to four Winchester Hard Disks (8" or 14"), four 5 1/4" Floppy Disk Drives and/or up to eight 8" Floppy Disk Drives may be in use at one time.

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- Hard or Soft sector diskette usage

- Utilization of "Quad" density (96 tpi) 8" or 5 1/4" Disk Drives

- Control of up to four WINCHESTER type PRIMA DISKS Disk Drives

- 8" or 14" may intermix on the same cable

- Accommodates 8" and/or 14" drives of 10.6 Mbytes to 154 Mbytes

- Ultra-Fast data transfers

- Extremely flexible host-controller interfacing

### SPECIFIC SOFTWARE

#### FEATURES INCLUDE:

- Dynamic format modifications via command words
- Extremely flexible format acceptance for unusual data storage formats
- Easily interfaces to standard operating systems (TRS-DOS\*, CP/M\*, etc.)
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THE TRS-80\* MOD II OMEGA—a Single Board, DMA Hard Disk Controller for the Radio Shack MOD II. OMEGA-MOD II.....\$725.95

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NOTE: OMEGA Controllers available soon for the TRS-80\* MOD I, STD BUS, and other systems. Consult SIRIUS SYSTEMS for current prices and availabilities.

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## TFORTH!—what it has to offer YOU!

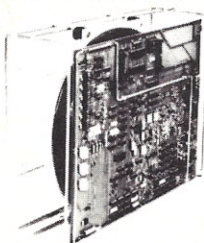
TFORTH is a procedural FORTH type language which specifies a process rather than a desired result. Designed to run on the TRS-80\*, TFORH is a very powerful tool by itself or used in conjunction with Assembly Programming. A rich set of WORDS come with TFORH and many features considered as "extra" with other FORTH languages are standard with TFORH. These features include:

- Advanced Math Package
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TFORTH from SIRIUS comes on diskette complete for the TRS-80\* with as little as 16K of memory and a single Disk Drive.

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PRIAM's high-performance, low-cost Winchester disc drives speed up throughput and expand data storage from 20 megabytes to 154 megabytes. And a single controller can be used to operate 14-inch-disc drives with capacities of 33, 66, or 154 megabytes or floppy-disc-size drives holding 20 and 34 megabytes. So it's easy to move up in capacity, or reduce package size, without changing important system elements or performance.

- Fast, Linear Voice Coil Positioning
- DC Power required only!
- 50 ms Average Positioning time
- 10 ms track-to-track positioning
- Simple, parallel Interface
- 90 ms Maximum Positioning Time
- Fully servoed head positioning
- Optional SMD Interface
- 6.4 ms Average Latency
- Dedicated servo tracks

### THE PRIAM LINEUP

Model/Disk Size	Capacity	Size	Weight	Price
DISKOS 2250(14")	22Mbytes	7" x 17" x 20"	33lbs.	\$2495
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DISKOS 2050 (8")	20 Mbytes	4.62" x 8.55" x 14.25"	20 lbs.	\$2995
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Optional SMD interface available for \$150.

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# The Ultimate Information Juggler

By Dr. Gordon Wolfe

What do wine cellars, magazine publishers, university research directors, physicians and stockbrokers all have in common? The answer is simple: they all need to store and rapidly access information.

This fact was brought home to me a while ago when I was called into the office of the associate director of research at the university where I teach. The graduate school (which houses the university research administration) was thinking about buying a small computer, and wanted my advice on what sort of equipment to look into.

I was no stranger to the office. My job requires me to spend 50 percent of my time in original research, much of which involves the scientific applications of microcomputers and microprocessors. In addition, I run a small consulting business helping people select and set up microcomputers.

I gave the director my usual advice, and told him to be careful that software for *his* particular application was available and working on the machine he chose. It was then that my curiosity got the better of me, and I asked what applications the graduate school had in mind for their possible computer. I expected the usual accounting applications, because of all the research contracts and grants that go through the office.

I was surprised to find that accounting was only a small part of what they wanted to do. Indeed, the university accounting and auditing

Sample 1.

\*  
OPTION LIST

0 EXIT TO BASIC  
1 PRINT CONTENTS OF FILE  
2 ENTER NEW FILE  
3 MODIFY ENTRIES IN A FILE  
4 SEARCH ON TITLES  
5 DELETE A FILE  
6 ADD ENTRY TO FILE  
7 DELETE ENTRY FROM FILE

OPTION NUMBER ? 2  
FILE NAME (NO EXT) ? WINLST  
DRIVE NUMBER (0 OR 1) ? 0  
TOTAL NUMBER OF ENTRIES ? 5  
COLUMNS OF DATA EACH ENTRY ? 7  
COLUMN 1  
DATA TYPE: ALPHA, NUMBER, OR DATE ? A  
COLUMN TITLE ? VARIETY  
COLUMN 2  
DATA TYPE: ALPHA, NUMBER, OR DATE ? A  
COLUMN TITLE ? VINTNER  
COLUMN 3  
DATA TYPE: ALPHA, NUMBER, OR DATE ? N  
COLUMN TITLE ? YEAR  
COLUMN 4  
DATA TYPE: ALPHA, NUMBER, OR DATE ? D  
COLUMN TITLE ? BOUGHT  
COLUMN 5  
DATA TYPE: ALPHA, NUMBER, OR DATE ? N  
COLUMN TITLE ? COST/B  
COLUMN 6  
DATA TYPE: ALPHA, NUMBER, OR DATE ? N  
COLUMN TITLE ? #BOT  
COLUMN 7  
DATA TYPE: ALPHA, NUMBER, OR DATE ? A  
COLUMN TITLE ? TYPE  
ENTRY NO. 1  
ENTER VARIETY  
? CABERNET  
ENTER VINTNER  
? MARTIN  
ENTER YEAR  
? 1973  
ENTER BOUGHT  
DATE (MO, DAY, YR) ? 3, 4, 74  
ENTER COST/B  
? 4.50  
ENTER #BOT

More

Dr. Gordon Wolfe is an assistant professor of physics at the University of Mississippi, University, MS 38677.



Sample 1 continued.

```
? 12
ENTER TYPE
? BURGUNDY
ENTRY NO. 2
ENTER VARIETY
? JOHANN.R
ENTER VINTNER
? MONDAVI
ENTER YEAR
? 1976
ENTER BOUGHT
DATE (MO, DAY, YR) ? 6, 11, 78
ENTER COST/B
? 6.10
ENTER #BOT
? 2
ENTER TYPE
? WI DELETED
WHIG DELETED
WI DELETED
WHITE
ENTRY NO. 3
ENTER VARIETY
? RHINE
ENTER VINTNER
? GALLO
ENTER YEAR
? 79
ENTER BOUGHT
DATE (MO, DAY, YR) ? 4, 25, 80
ENTER COST/B
? 1.54
ENTER #BOT
? 200
ENTER TYPE
? WHITE
ENTRY NO. 4
ENTER VARIETY
? PORT
ENTER VINTNER
? MASSON
ENTER YEAR
? 1965
ENTER BOUGHT
DATE (MO, DAY, YR) ? 7, 11, 75
ENTER COST/B
? 6.22
ENTER #BOT
? 1
ENTER TYPE
? DESSERT
ENTRY NO. 5
ENTER VARIETY
? NECTAR
ENTER VINTNER
? ALMADEN
ENTER YEAR
? 78 DELETED
1978
ENTER BOUGHT
DATE (MO, DAY, YR) ? 2, 15, 79
ENTER COST/B
? 3.11 DELETED
3.11
ENTER #BOT
? 4
ENTER TYPE
? ROSE
```

\*

#### OPTION LIST

- 0 EXIT TO BASIC
- 1 PRINT CONTENTS OF FILE
- 2 ENTER NEW FILE
- 3 MODIFY ENTRIES IN A FILE

(More →)

department would really take care of most of that, as they are doing now. What the graduate school wanted was a machine for the following applications:

- Word processing—writing proposals and project reports to government and private funding agencies.

- Information storage and retrieval—storing information on what applications for grants have been made, to whom, for how much, by whom, from what department, and selectively retrieving them by category. (For instance, determining how many proposals for amounts over \$30,000 were made by the physics department in 1979.)

- Keeping a file on the areas of expertise of faculty members, and searching them as needed for funding of research projects. (The EPA is requesting proposals on effects of pesticides on freshwater crustaceans. Who do we have that knows anything about pesticides and/or crustaceans?)

- Keeping the graduate school's intramural and extramural mailing lists.

The last three of the above tasks are all essentially the same type of task, but with different specific applications. That is, they all store information, and then selectively retrieve it to give information on the status of specific operations.

Indeed, in large systems, this is one of the more common uses of a computer: the storage and manipulation of large amounts of data in a utilitarian and task-determined manner. Somehow, this manipulation, which is called data base management, has been more or less overlooked on the microcomputer.

### Unlimited Opportunities

The possibilities of a data base management system are limited only by the imagination of the user. A few possible applications are:

- Keeping a catalog of a wine cellar.
- Keeping up with a stock portfolio.
- A directory of personnel expertise.
- A doctor's list of prescribed drugs, allergies and diagnoses for a particular patient.
- A mailing list for newsletters or Christmas cards.
- Indexing articles in back issues of your magazines or newsletters.

Some data base management programs have been written for micros. But for the most part they are oriented toward specific applications, or limit the types of data used in some

way. Examples include the many mailing-list programs (usually cassette or memory-resident files), the wine list program of Rodney Jolliffe ("Computerized Wine Cellar," *Byte*, February 1979, p. 128) or the club management program of Thomas Doyle ("Do-All-Plus," *Microcomputing*, April 1980, p. 164). Peter Reese has written a more general data base program, which is oriented toward string searches and sorts ("Complete Data Base Management System," *Interface Age*, August 1978, p. 108), but this was still not general enough for the application I had in mind.

A complete data base management program should do the following:

1. Keep files on disk so that file size is not limited by available memory, or speed limited by the cassette recorder.

2. Allow input, printing, deletion and modification of files. (Add or delete entries or modify data within an entry.)

3. Keep data for alphanumeric strings, numerical quantities or dates (which are, after all, a set of three numbers).

4. Allow a search on a file for all entries which meet one or more criteria, and either print the results of the search, or make the results available for further manipulations or numerical calculations.

5. Keep titles for the categories in the file, and keep track of what types (i.e., alpha, numeric or date) of data are present in the file, and where they are.

6. Be usable in as many applications as possible, and be self-explanatory in its use.

### Program Features

With these capabilities in mind, I wrote the program DATBAS (Listing 1) in Computerware Disk File BASIC version 5.5 for the Smoke Signal Broadcasting BFD-68 disk system on the SWTP 6800. It requires 5K of program space above the 11K disk file BASIC, so at least 16K of memory is required. The BASIC uses sequential disk files, so to edit files, a new file is created, the old file, with modifications, is read into it, and the old file is deleted. File size is limited only by the size of the disk.

All information is kept on a file on the disk. When asked for the name of the file, you can input any string of letters or numbers. The program will truncate the string to a maximum of six characters, and add the extension



.DAT, so that all data files will have the extension .DAT. A file contains N entries, or individual pieces of information.

Within each entry, there are N1 categories (up to 10). Each category can be alphanumeric, numeric or a date (which will be stored as a numeric quantity in the format [day+100\*month+10000\*year]. It is best to use only the last two numbers of the year.) The type of category and the title of each category, along with the numbers N and N1, are stored on disk as a file header, and are followed by the data for each entry in sequence. Once entered, the number and arrangement of categories may not be changed by DATBAS.

The program DATBAS is written as a structured program, permitting easy modifications to your system. An executive routine oversees the particular procedure being used. These procedures are written as separate routines and are called from the executive. A series of subroutines (all included in line numbers from 1000 to 2980) handles processes used by more than one process routine, such as read a data file header, or write an entry to a file, etc. All routines and subroutines have line numbers, which are even hundreds, and all are identified by plentiful remark statements.

Sample 1 continued.

```

4 SEARCH ON TITLES
5 DELETE A FILE
6 ADD ENTRY TO FILE
7 DELETE ENTRY FROM FILE
OPTION NUMBER ? 1
FILE NAME (NO EXT) ? WN DELETED
WINLST
OUTPUT ON SCREEN, PRINTER,
OR DISK ? S

```

	TYPE	VARIETY	VINTNER	YEAR	BOUGHT	COST/B	#BOT
1	CABERNET MARTIN			1973	3/4/74	4.5	12
2	BURGUNDY						
3	JOHANN. R MONDAVI			1976	6/11/78	6.1	2
4	WHITE						
5	RHINE	GALLO		79	4/25/80	1.54	200
6	WHITE						
7	PORT	MASSON		1965	7/11/75	6.22	1
8	DESSERT						
9	NECTAR	ALMADEN		1978	2/15/79	3.11	4
10	ROSE						

PRESS RETURN TO CONTINUE  
?

Upon execution of DATBAS, the executive prints the menu of services and asks for the process desired in terms of an option number.

### Options

Sample 1 illustrates the option list printout and the selection of option 2, which creates a new file and sets up the category information. The sample

run is an example of the use of DATBAS as a management program for a private wine cellar.

After selection of the option and entry of the file name and drive number, the program will ask for the number of entries. (In this case, the number of different types of wine purchases to be entered at this time.) Then the program will ask for the

### \* OPTION LIST

```

0 EXIT TO BASIC
1 PRINT CONTENTS OF FILE
2 ENTER NEW FILE
3 MODIFY ENTRIES IN A FILE
4 SEARCH ON TITLES
5 DELETE A FILE
6 ADD ENTRY TO FILE
7 DELETE ENTRY FROM FILE

```

```

OPTION NUMBER ? 1
FILE NAME (NO EXT) ? MAILST
OUTPUT ON SCREEN, PRINTER,
OR DISK ? S

```

	NAME	ADDR	CITY/ST	ZIP
1	G. WOLFE	PHYSICS DEPT		
		UNIVERSITY MS		38677
2	J. CARTER	1600 PENNSYLVANIA		
		WASHINGTON DC		20044
3	W. GREEN	PINE ST	PETERBOROUGH NH	3458

PRESS RETURN TO CONTINUE  
?

Sample 2.

### \* OPTION LIST

```

0 EXIT TO BASIC
1 PRINT CONTENTS OF FILE
2 ENTER NEW FILE
3 MODIFY ENTRIES IN A FILE
4 SEARCH ON TITLES
5 DELETE A FILE
6 ADD ENTRY TO FILE
7 DELETE ENTRY FROM FILE

```

```

OPTION NUMBER ? 6
FILE NAME (NO EXT) ? PATNT
HOW MANY NEW ENTRIES ? 1
ENTRY NO. 4
ENTER NAME
? L. BORGIA
ENTER FIRST VISIT
DATE (MO, DAY, YR) ? 1, 2, 34
ENTER ACCOUNT
? 12.50
ENTER ALLERGIES
? ARSENIC
ENTER PRESCRIPTION
? ETHYL ALCOHOL
ENTER VISIT DATE
DATE (MO, DAY, YR) ? 4, 3, 80

```

Sample 3.



# OPTION LIST

- 0 EXIT TO BASIC
- 1 PRINT CONTENTS OF FILE
- 2 ENTER NEW FILE
- 3 MODIFY ENTRIES IN A FILE
- 4 SEARCH ON TITLES
- 5 DELETE A FILE
- 6 ADD ENTRY TO FILE
- 7 DELETE ENTRY FROM FILE

OPTION NUMBER ? 1

FILE NAME (NO EXT) ? SOCKS

FILE 1: SOCKS.DAT NOT FOUND

FILE NAME (NO EXT) ? STOCKS

OUTPUT ON SCREEN, PRINTER,

OR DISK ? S

	STOCK	NO. SHARES	DATE PURCHASED	COST	VALUE
1	ITT	100	2/21/54	23	34
2	IBM	200	5/11/69	112	223
3	KRO	300	1/4/80	0.28	0.01
4	XXX	10	9/1/76	22	33

PRESS RETURN TO CONTINUE

?

## \* OPTION LIST

- 0 EXIT TO BASIC
- 1 PRINT CONTENTS OF FILE
- 2 ENTER NEW FILE
- 3 MODIFY ENTRIES IN A FILE
- 4 SEARCH ON TITLES
- 5 DELETE A FILE
- 6 ADD ENTRY TO FILE
- 7 DELETE ENTRY FROM FILE

OPTION NUMBER ? 3

FILE NAME (NO EXT) ? STOCKS

MODIFY HOW MANY ENTRIES ? 3

ITEM NUMBERS TO MODIFY

? 3

? 4

? 1

ENTRY NO. 1

ENTER STOCK

? ITT

ENTER NO. SHARES

? 100

ENTER DATE PURCHASED

DATE (MO, DAY, YR) ? 2, 21, 54

ENTER COST

? 23

ENTER VALUE

? 41

ENTRY NO. 3

ENTER STOCK

? KRO

ENTER NO. SHARES

? 200

ENTER DATE PURCHASED

DATE (MO, DAY, YR) ? 1, 4, 80

ENTER COST

? .28

ENTER VALUE

? 0

ENTRY NO. 4

ENTER STOCK

? XXX

ENTER NO. SHARES

? 10

ENTER DATE PURCHASED

DATE (MO, DAY, YR) ? 9, 1, 76

ENTER COST

? 22

ENTER VALUE

? 445

Sample 4.

number of categories to be included in each entry in the data base.

In the example, the wine will be categorized by variety, vintner, vintage year, date of purchase, cost per bottle, number of bottles in that purchase and wine type (red, white, rose, dessert, aperitif or sparkling). There are seven categories, so seven is input in response to the prompt. For each category, the user is asked for the type of data (alpha, numeric or date) and the title of the category. Using this information, the disk file header is prepared. Then, for each entry, the information is requested by the title of the category, until all N entries have data for them.

Option 1 is also shown in the example, giving a nice neat printout of the file in table format.

Sample 2 is an example of the use of the table print option to print a mailing list. Additional categories here might include subscription expiration dates, or officer titles if this was a newsletter for an organization or club. The search option could then be used to print only nonexpired subscriptions on the printer, or only expired subscriptions so that reminder notices may be sent. The same may be said for printing a list of subscriptions about to expire in, say, the next 60 days.

Sample 3 shows how a physician might use option 6 to add a new entry to his file of patient visit records. The prompts for the entry are, again, just the titles of the categories.

Sample 4 shows the use of option 1

Sample 5.

\*

## OPTION LIST

- 0 EXIT TO BASIC
- 1 PRINT CONTENTS OF FILE
- 2 ENTER NEW FILE
- 3 MODIFY ENTRIES IN A FILE
- 4 SEARCH ON TITLES
- 5 DELETE A FILE
- 6 ADD ENTRY TO FILE
- 7 DELETE ENTRY FROM FILE

OPTION NUMBER ? 1

FILE NAME (NO EXT) ? RESRCH

OUTPUT ON SCREEN, PRINTER,

OR DISK ? S

	P. I.	AMOUNT	APPLIED FOR	STATUS	AGENCY
1	A. EINSTEIN	300000	1/1/53	FUNDED	AEC
2	M. SNERD	1.5	2/30/60	DENIED	CIA
3	A. CAPONE	25000	9/12/29	DENIED	FBI

PRESS RETURN TO CONTINUE

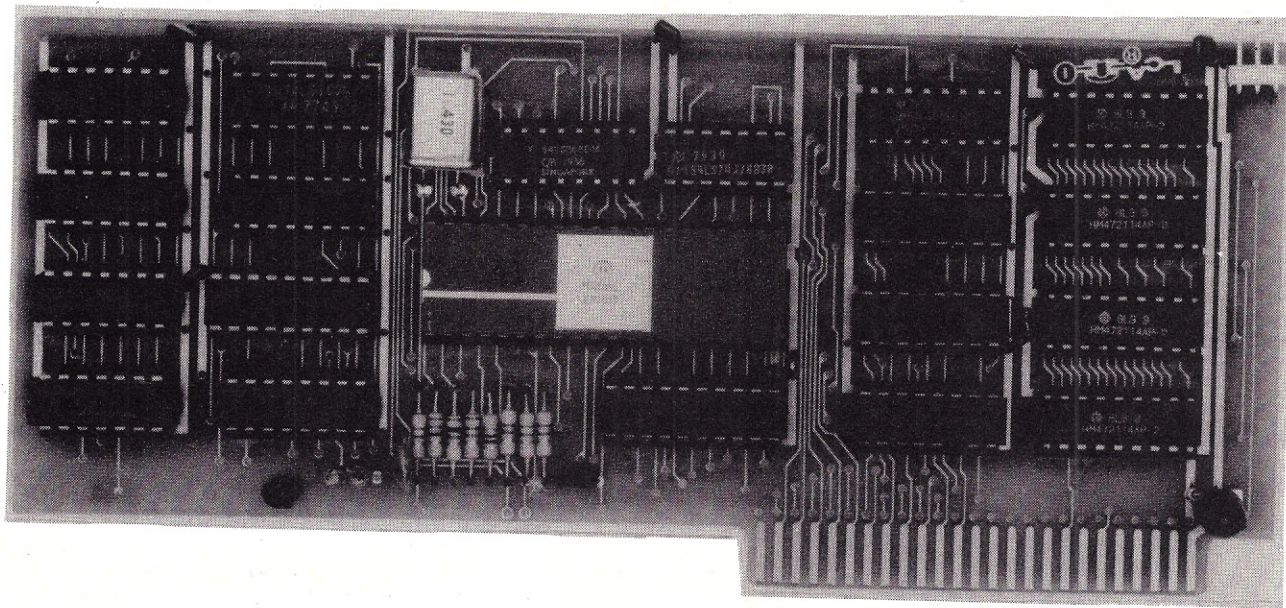
?

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Sample 5 continued.

\*  
OPTION LIST

- 0 EXIT TO BASIC
- 1 PRINT CONTENTS OF FILE
- 2 ENTER NEW FILE
- 3 MODIFY ENTRIES IN A FILE
- 4 SEARCH ON TITLES
- 5 DELETE A FILE
- 6 ADD ENTRY TO FILE
- 7 DELETE ENTRY FROM FILE

OPTION NUMBER ? 4  
FILE NAME (NO EXT) ? RESRCH  
SEARCH ON HOW MANY CATEGORIES ? 2  
OUTPUT ON SCREEN, PRINTER,  
OR DISK ? S

- \*
- 1 P.I.
  - 2 AMOUNT
  - 3 APPLIED FOR
  - 4 STATUS
  - 5 AGENCY

INPUT NUMBERS OF SEARCH CATEGORIES  
? 3  
? 4,  
ITEM 3 APPLIED FOR  
LATEST  
DATE (MO, DAY, YR) ? 12, 31, 79  
EARLIEST  
DATE (MO, DAY, YR) ? 1, 1, 60  
ITEM 4 STATUS  
SEARCH STRING ? DENIED

to print the stock portfolio for an executive. The value of the stocks changes on an hourly basis, so the executive might run option 3 once a week or so to update the value of the stocks. Three of the entries—items 1, 3 and 4 in the list—are to have the category "present value" changed during the week of the example. Note that modification (or deletion, for that matter) is based on entry number for simplicity. Entry numbers can be input in any order; the program will sort them into ascending order. To modify an entry, the entire entry is reentered with modified data.

If a stock is doing well, a user might make an additional purchase of that stock and use option 6 to make the new entry. The search option could then be used to look at the total per-

```
0900 REM SUBROUTINE TO READ DATA FILE
0910 REM HEADER CREATED BY DATBAS. BAS
0920 REM FILE NAME IN F$ WITH EXTENSION
```

```
0930 REM .DAT
0940 REM T$ HAS TITLES OF CATEGORIES
0950 REM C HAS INFO WHETHER COLUMN J
0960 REM 1=ALPHANUMERIC
0970 REM 2=NUMERIC
0980 REM 3=DATE (DAY+100*MO+10000*YEAR)
1000 DIM T$(10), A$(10), C(10), C(10)
1010 OPEN #1, F$
1020 IF STATUS#1=0 THEN 1050
1030 PRINT "FILE "; F$; " NOT FOUND"
1040 END
1050 READ #1, X
1060 IF STATUS#1=6 THEN 1090
1070 LET N1=N: N=X
1080 GOTO 1050
1090 RESTORE #1
1100 FOR I=1 TO N
1110 FOR J=1 TO N1
1120 READ #1, X
1130 NEXT J
1140 NEXT I
1150 FOR J=1 TO N1
1160 READ #1, T$(J), C(J)
1170 NEXT J
1180 RESTORE #1
1185 LET I=1
1190 RETURN
1200 REM SUBROUTINE TO READ ENTRY I
1201 REM FROM FILE CREATED BY DATBAS. BAS
```

```
1202 REM SUBROUTINE 1000 MUST BE
1203 REM EXECUTED FIRST AND
1204 REM THIS ROUTINE CALLED FROM
1205 REM A FOR-NEXT LOOP INDEXED I
1220 FOR J=1 TO N1
1230 ON C(J) GOTO 1240, 1260, 1260
1240 READ #1, A$(J)
1250 GOTO 1270
1260 READ #1, A(J)
1270 NEXT J
1280 IF I=N THEN CLOSE #1
1290 RETURN
```

Listing 2. Subroutine to read the new disk file.

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formance of all holdings of the stock, and to make a record of long-term capital gains at tax time.

Option 4 is the key to the entire program. Up to this point, we have merely discussed the storage and retrieval of data; now it is time to look at selective retrieval. An example of the use of option 4 is shown in Sample 5.

In this sample run, a college is keeping tabs on the proposals written for government grants. The file is printed out to show, in this example, that a total of three proposals have been written. The name of the investigator, the amount applied for, the date of application, whether the request was funded, denied, or still pending, and the funding agency are all stored in the file.

The director of research might want to know how many funding requests were denied during the 20-year period of the 1960s and 1970s. Instead of having a secretary spend days digging through the back files, he merely executes option 4 on the file RESRCH.

He wants to know two things: how many were denied and how many of these denials fell in those two decades? This requires a search on two categories: transmittal date and status. He punches in that the search is to be over two categories and specifies categories 3 and 4, which are the categories specified above. Since item 3 is a date, he must also input the range of the search—what starting and ending dates are to be looked for. S search string "denied" must be input for the funding status.

At this point, the program will read each entry from the file and determine if the transmittal date is within the range specified, and, if so, also determine if the "status" string contains the substring "denied," and will print all entries which meet both these criteria. Entry no. 2 is the only one so doing, and is the only one printed.

The director could just as easily have asked for all proposals still pending from the CIA, or for all proposals submitted in 1979 from a particular department (if department had been one of the categories).

The end of a search is rarely the end of the information. Usually, some other procedure needs to be done. The research director might want to know the total dollar amount of all funds granted in 1979. Or a stockbroker might want to know the

net capital gain per share of a particular stock if he sold now. A statistical analysis on the data or a sort on names might be required. All of these situations could be programmed into DATBAS, but each person's needs will be different. It would be impossible to write a general-purpose analysis program which would satisfy even a moderate percentage of data base users.

With that in mind, a provision has been made in DATBAS for the user to write his own codes for the analysis of searched data. The output of the search can be directed to disk. That is, all entries which meet the search criteria will be placed in a disk file,

the name of which the user may choose, along with header information, so that results of the search can be accessed by another analysis program. The only difficulty is that the output file does not have the same format, and cannot be used as an input file in DATBAS. This was done to save processing time, as it would require two searches—one to find the total number of items which satisfy the search and one to list those items on disk.

Instead, the new disk file is created in a single pass and has a slightly different format. Title and category type is still stored. To read the new disk file, a set of subroutines is provided

Listing 1. DATBAS program for the SWTP.

```
*
0010 REM DATA BASE MANAGEMENT
0015 REM COPYRIGHT 1980
0020 REM BY GORDON W. WOLFE
0030 REM PHYSICS DEPT., UNIVERSITY
0040 REM OF MISSISSIPPI
0050 REM ALL RIGHTS RESERVED
0055 REM THIS PROGRAM MAY NOT BE COPIED
0060 REM BY ANY PROCESS, INCLUDING BUT NOT
0065 REM LIMITED TO XEROGRAPHIC OR
0070 REM ELECTRONIC METHODS WITHOUT
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0090 REM THEIR PERSONAL OR BUSINESS USE,
0095 REM BUT NOT FOR FURTHER SALE OR
0096 REM DISTRIBUTION
0099 REM -----
0100 DATA .DAT, TEMP.DAT
0110 READ E$,D$
0115 STRING= 20
0120 DIM T$(10),C(10),A(10),B(10),B$(10)S$(10),S(10,2)
0140 GOSUB 2300
0200 REM PRINT MENU
0210 PRINT CHR$(16);CHR$(11);CHR$(11);:HOME
0220 PRINT "OPTION LIST":PRINT
0230 PRINT 0;TAB(4);"EXIT TO BASIC"
0240 PRINT 1;TAB(4);"PRINT CONTENTS OF FILE"
0250 PRINT 2;TAB(4);"ENTER NEW FILE"
0260 PRINT 3;TAB(4);"MODIFY ENTRIES IN A FILE"
0270 PRINT 4;TAB(4);"SEARCH ON TITLES"
0280 PRINT 5;TAB(4);"DELETE A FILE"
0285 PRINT 6;TAB(4);"ADD ENTRY TO FILE"
0290 PRINT 7;TAB(4);"DELETE ENTRY FROM FILE"
0300 PRINT
0310 INPUT "OPTION NUMBER",O
0320 LET O=INT(O)
0330 IF O<=0 THEN END
0340 IF O>7 THEN END
0350 ON O GOTO 500,700,4000,4500,400,3000,3500
0400 REM DELETE FILE
0410 GOSUB 1000
0412 LET F=1
0415 GOSUB 1100
0417 IF N4=1 THEN 410
0420 FDEL F$
0430 PRINT "FILE ";F$;" DELETED"
0440 GOTO 200
0500 REM PRINT A FILE
0510 GOSUB 1000
0515 LET F=1
0520 GOSUB 1100
```

More



in Listing 2. To use these subroutines, first the name of the search data file with extension .DAT must be placed into the string variable F\$. To initialize the file and read the header information, execute a GOSUB 1000 from your analysis routine.

Upon return from this subroutine, the array T\$(J) will contain the title of the columns, with column number J. C(J) will indicate the data type of column J. C=1 if alphanumeric data is present, C=2 if the column is numeric, and C=3 if the data in the column is a date. The variable N will contain the number of entries in the table, and N1 will have the total number of columns or categories.

To read an entry from the file, execute a GOSUB 1200 from the analysis routine. This will read the next entry from the file. If no entries have been read previously, the first entry will be read. If the entry read is the last entry, the file will be closed. Upon reading the entry, data will be placed either in the string array A\$(J) if the data for column J is alphanumeric, or into the numeric array A(J) if the data for column J is a numeric or date quantity. Notice that alpha and numeric data is intermixed. A\$(1) can have data, but A\$(2) cannot have data if column 2 is a numeric quantity—the data will be placed in A(2) instead. The array C(J) tells whether the data for column J is in A\$(J) or in A(J). Be very careful with this. Also, the number of the next entry to be read from the file is kept in variable I, which should not be changed by the calling program or a disk error could result, or data might be lost.

### Modifications

Modification of the program for individual needs may range from simple to quite difficult, depending on the hardware and disk file BASIC being used. Rather complete use of the provisions of Computerware's sequential disk file BASIC is made in DATBAS. The disk file is treated as a large DATA statement, so that READ and RESTORE work much the same as with a DATA statement. OPEN, CLOSE and WRITE are fairly standard disk commands. Not so standard are the FREN and FDEL commands to rename and delete files, or the STATUS function to determine if the file is open, closed, ended or non-existent.

To use more than ten categories of data, some minor changes are required. First and foremost is the di-

### Listing 1 continued.

```

0525 IF N4=1 THEN 510
0530 GOSUB 1600
0540 IF N2<>8 THEN 570
0550 PRINT "DISK COPY NOT NECESSARY"
0560 GOSUB 1600
0565 GOTO 540
0570 GOSUB 2000
0572 FOR J=1 TO N1
0574 PRINT #N2, TAB(J*9); T$(J);
0576 NEXT J
0578 PRINT #N2: PRINT#N2
0580 FOR I=1 TO N
0590 GOSUB 1400
0600 FOR J=1 TO N1
0610 GOSUB 1700
0620 NEXT J
0630 LET N3=N1
0640 GOSUB 1800
0650 NEXT I
0670 GOSUB 1900
0675 CLOSE #F
0680 GOTO 200
0700 REM ENTER NEW FILE
0710 GOSUB 1000
0720 OPEN #1, F$
0730 INPUT "TOTAL NUMBER OF ENTRIES",N
0740 INPUT "COLUMNS OF DATA EACH ENTRY",N1
0750 FOR J=1 TO N1
0760 PRINT "COLUMN ";J
0770 INPUT "DATA TYPE: ALPHA, NUMBER, OR DATE",Y$
0780 LET Y$=LEFT$(Y$,1)
0790 LET N4=0
0800 IF Y$="A" THEN N4=1
0810 IF Y$="N" THEN N4=2
0820 IF Y$="D" THEN N4=3
0830 IF N4=0 THEN 770
0850 LET C(J)=N4
0860 INPUT "COLUMN TITLE",T$(J)
0870 NEXT J
0880 LET F=1:N4=N:N5=N1
0890 GOSUB 2100
0900 FOR I=1 TO N
0910 GOSUB 2900
0960 GOSUB 1500
0970 NEXT I
0980 CLOSE #F
0990 GOTO 200
1000 REM INPUT FILE NAME
1010 INPUT "FILE NAME (NO EXT)",F$
1020 LET F$=LEFT$(F$,6)+E$
1025 IF 0=2 THEN 1030
1027 IF 0=5 THEN 1030
1029 GOTO 1060
1030 INPUT "DRIVE NUMBER (0 OR 1)",D
1040 IF D=1 THEN F$="1:" + F$
1050 IF D<>0 THEN 1030
1060 RETURN
1100 REM SEARCH FOR FILE
1105 LET N4=0
1110 OPEN #F, F$
1120 IF STATUS #F=0 THEN RETURN
1130 IF D=0 THEN F$="1:" + F$
1140 IF D=1 THEN F$=MID$(F$,3,LEN(F$))
1150 OPEN #F, F$
1160 IF STATUS #F=0 THEN RETURN
1170 PRINT "FILE ";F$;" NOT FOUND"
1180 LET N4=1
1190 RETURN
1200 REM CONVERT DATE TO NUMBER D1
1210 INPUT "DATE (MO, DAY, YR)",D2,D1,D3
1220 LET D1=100*D2+D1+10000*D3
1230 RETURN
1300 REM CONVERT NUMBER TO DATE
1310 LET D3=INT(D1/10000)
1320 LET D2=INT((D1-D3*10000)/100)
1330 LET D1=INT(D1-10000*D3-100*D2)
1340 RETURN

```

More →

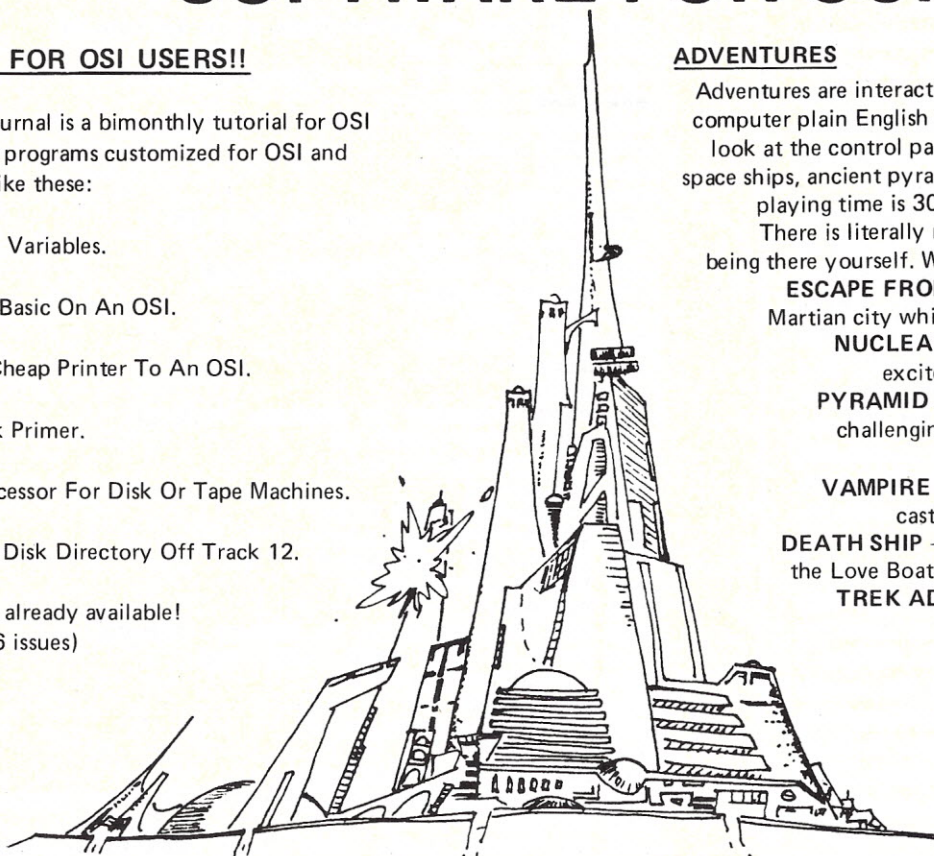


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mension statement at line 120. There are also the 10s in lines 3552, 3554, 4090, 4080, 4570 and 4580.

All of the PRINT statements, especially the one in line 1830, may have to be modified depending on your printer and BASIC. I had considerable difficulty with print formatting, as the sample runs will attest.

Lastly, a few of the subroutines in DATBAS might be of use to you in reading search files and manipulating the data therein. Specifically, I have in mind the subroutines at lines 1300 (converts a numerical quantity to a date by changing the number stored in D1 to three numbers—D1, D2 and D3, corresponding to day, month and year, respectively) and 2600 (which sorts an array B(1) into ascending numerical order).

The purpose of a computer is to make our lives and jobs easier. One of the things they're best at is storing and sorting information. When I showed this program and the results to the associate director, his response was, "If I can get a computer to do all this for me, I won't have to hire a fifth secretary." As for me, I'm going to go catalog all the music for my banjo. ■

Listing 1 continued.

```

1400 REM READ AN ENTRY FROM FILE #F (NO.1)
1410 FOR J=1 TO N1
1420 ON C(J) GOTO 1430,1450,1450
1430 READ #F,A$(J)
1440 GOTO 1460
1450 READ #F,A(J)
1460 NEXT J
1470 RETURN
1500 REM WRITE AN ENTRY TO FILE #F
1510 FOR J=1 TO N1
1520 ON C(J) GOTO 1530,1550,1550
1530 WRITE #F,A$(J)
1540 GOTO 1560
1550 WRITE #F,A(J)
1560 NEXT J
1570 RETURN
1600 PRINT "OUTPUT ON SCREEN, PRINTER,"
1610 INPUT "OR DISK",Y$
1620 LET Y$=LEFT$(Y$,1)
1625 LET N2=-1
1630 IF Y$="S" THEN N2=1
1640 IF Y$="P" THEN N2=7
1650 IF Y$="D" THEN N2=8
1660 IF N2<0 THEN 1600
1670 RETURN
1700 REM CONVERT DATA TO STRING FOR COL J
1710 ON C(J) GOTO 1720,1740,1760
1720 LET B$(J)=A$(J)
1730 GOTO 1780
1740 LET B$(J)=STR$(A(J))
1750 GOTO 1780
1760 LET D1=A(J):GOSUB 1300
1770 LET B$(J)=STR$(D2)+"/"+STR$(D1)+"/"+STR$(D3)
1780 RETURN
1800 REM PRINT ENTRY I;N3 ITEMS INB$;DEVICE N2
1810 PRINT #N2,I;
1820 FOR J=1 TO N3
1830 PRINT #N2,TAB(J*9);B$(J);
1840 NEXT J
1850 PRINT #N2
1860 RETURN
1900 REM KEEP DISPLAY UNTIL DONE
1910 PRINT "PRESS RETURN TO CONTINUE"
1920 INPUT Y$
1930 RETURN
2000 REM READ HEADER FROM FILE
2005 READ #F,N,N1
2010 FOR J=1 TO N1
2020 READ #F,T$(J)
2030 NEXT J
2040 FOR J=1 TO N1
2050 READ #F,C(J)
2060 NEXT J
2070 RETURN
2100 REM WRITE HEADER TO FILE F
2110 WRITE #F,N4,N5
2120 FOR J=1 TO N5
2130 WRITE #F,T$(J)
2140 NEXT J
2150 FOR J=1 TO N5
2160 WRITE #F,C(J)
2170 NEXT J
2180 RETURN
2200 REM RENAME TEMP.BAS TO F$
2220 IF LEFT$(F$,2)<>"1:" THEN 2270
2225 OPEN #1,D$,#2,F$
2230 LET F=1:GOSUB 2000
2233 LET N4=N1:N5=N2
2235 LET F=2:GOSUB 2100
2240 FOR I=1 TO N
2242 LET F=1
2244 GOSUB 1400
2246 LET F=2
2248 GOSUB 1500
2250 NEXT I
2255 CLOSE #1,#2
2257 FDEL D$

```



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Listing 1 continued.

```

2260 RETURN
2270 FREN D$, F$
2280 RETURN
2300 FOR I=1 TO 10
2310 LET B(I)=0
2320 NEXT I
2330 RETURN
2500 REM DELETE F$ IF F$ ON SAME DRIVE ASD$
2510 REM D$ ALWAYS ON DRIVE 0
2520 IF LEFT$(F$,2)="1:" THEN 2550
2530 FDEL F$
2550 RETURN
2600 REM SORT B(I) INTO ASCENDING ORDER
2610 FOR K=1 TO N6
2620 LET G=1.E99
2630 FOR I1=K TO N6
2640 IF B(I1)>G THEN 2680
2650 LET G=B(I1)
2660 LET B(I1)=B(K)
2670 LET B(K)=G
2680 NEXT I1
2690 NEXT K
2695 RETURN
2900 PRINT "ENTRY NO. "; I
2910 FOR J=1 TO N1
2915 PRINT "ENTER "; T$(J)
2920 ON C(J) GOTO 2925, 2935, 2945
2925 INPUT A$(J)
2930 GOTO 2955
2935 INPUT A(J)
2940 GOTO 2955
2945 GOSUB 1200
2950 LET A(J)=D1
2955 NEXT J
2960 RETURN
3000 REM ADD ENTRIES TO FILE
3010 GOSUB 1000
3020 LET F=1
3030 GOSUB 1100
3040 IF N4=1 THEN 3010
3050 INPUT "HOW MANY NEW ENTRIES", N6
3060 GOSUB 2000
3070 LET N4=N+N6: N5=N1
3080 OPEN #2, D$
3090 LET F=2
3100 GOSUB 2100
3110 FOR I=1 TO N
3120 LET F=1
3130 GOSUB 1400
3140 LET F=2
3150 GOSUB 1500
3160 NEXT I
3170 FOR I=N+1 TO N4
3180 GOSUB 2900
3190 GOSUB 1500
3200 NEXT I
3210 CLOSE #1, #2
3215 GOSUB 2500
3220 GOSUB 2200
3240 GOTO 200
3500 REM DELETE AN ENTRY FROM A FILE
3505 GOSUB 2300
3510 GOSUB 1000
3520 LET F=1
3530 GOSUB 1100
3540 IF N4=1 THEN 3510
3550 INPUT "DELETE HOW MANY ENTRIES", N6
3552 IF N6<=10 THEN 3560
3554 PRINT "MAXIMUM 10"
3556 GOTO 3550
3560 GOSUB 2000
3570 LET N4=N+N6: N5=N1
3580 OPEN #2, D$
3590 LET F=2
3600 GOSUB 2100
3610 PRINT "ITEM NUMBERS TO DELETE"
3620 FOR I=1 TO N6

```

More

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1. 16K ZBASIC will compile a 48K program. (tape only)  
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2. ZBASIC DOES NOT support disk or tape files.
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6. ZBASIC programs may be used as USR routines from basic.
7. ZBASIC uses INTEGER MATH ONLY to increase speed and decrease compiled program size. Use of Single or Double precision would destroy the beauty of the first "INTERACTIVE COMPILER" on the market!
8. Limited variables: A-Z, A1-Z1, A2-Z2, A\$-Z\$. Arrays are not supported to decrease memory demands and speed up compiling of programs.
9. COMPILE TIMES ARE TYPICALLY 1 TO 10 SECONDS! THERE IS NO NEED TO USE COMPLICATED COMPILE TIME MODULES!
10. ZBASIC comes with a HIGHLY DETAILED manual describing all important memory locations, commands, variables, warm/cold start entry points and many useful sub-routines for emulating unsupported commands!!
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### ALL COMMANDS DIRECTLY SUPPORTED BY ZBASIC

FOR	NEXT	STEP	IF	THEN	ELSE	PEEK
SET	RESET	POINT	CHR\$	RANDOM	RND	POKE
DATA	READ	RESTORE	END	GOTO	GOSUB	CLS
INPUT	INKEY\$	LET	STOP	OUT	INP	RETURN
PRINT	LPRINT	PRINT@	USR	SGN	INT	ABS
SQR	LEN	ASC	VAL	STR\$	POS	ON GOTO
ON GOSUB	REM	NOT	AND	OR		

INTEGER MATH \*MULTIPLY /DIVIDE +ADD -SUBTRACT + - 32767  
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Listing 1 continued.

```

3630 INPUT B(I)
3640 NEXT I
3642 GOSUB 2600
3645 LET I1=1
3650 FOR I=1 TO N
3660 LET F=1
3670 GOSUB 1400
3680 IF B(I1)=I THEN 3720
3690 LET F=2
3700 GOSUB 1500
3710 GOTO 3730
3720 LET I1=I1+1
3730 NEXT I
3740 CLOSE #1,#2
3745 GOSUB 2500
3750 GOSUB 2200
3770 GOTO 200
4000 REM MODIFY ENTRIES IN A FILE
4010 GOSUB 1000
4020 LET F=1
4030 GOSUB 1100
4040 IF N4=1 THEN 4010
4050 GOSUB 2300
4060 OPEN #2,D$
4070 INPUT "MODIFY HOW MANY ENTRIES",N6
4080 IF N6<=10 THEN 4100
4090 PRINT "MAXIMUM 10":GOTO 4070
4100 GOSUB 2000
4110 LET F=2:N4=N:N5=N1
4120 GOSUB 2100
4130 PRINT "ITEM NUMBERS TO MODIFY"
4140 FOR I=1 TO N6
4150 INPUT B(I)
4160 NEXT I
4162 GOSUB 2600
4165 LET I1=1
4170 FOR I=1 TO N
4180 LET F=1
4190 GOSUB 1400
4200 IF I<>B(I1) THEN 4220
4205 LET I1=I1+1
4210 GOSUB 2900
4220 LET F=2
4230 GOSUB 1500
4240 NEXT I
4250 CLOSE #1,#2
4255 GOSUB 2500
4260 GOSUB 2200
4270 GOTO 200
4500 REM SEARCH ON MULTIPLE CATEGORIES
4510 GOSUB 1000
4520 LET F=1
4530 GOSUB 1100
4540 IF N4=1 THEN 4510
4550 GOSUB 2300
4560 INPUT "SEARCH ON HOW MANY CATEGORIES",N6
4570 IF N6<=10 THEN 4600
4580 PRINT "MAXIMUM 10"
4590 GOTO 4560
4600 GOSUB 1600
4610 IF N2<>8 THEN 4640
4620 OPEN #2,D$
4630 IF STATUS#2=0 THEN SCRATCH #2
4640 LET F=1
4650 GOSUB 2000
4660 HOME
4670 FOR J=1 TO N1
4680 PRINT J;TAB(4);T$(J)
4690 NEXT J
4700 PRINT
4710 PRINT "INPUT NUMBERS OF SEARCH CATEGORIES"
4720 FOR J=1 TO N6
4730 INPUT B(J)
4740 NEXT J
4745 GOSUB 2600
4750 FOR J=1 TO N6
4760 LET N4=B(J)

```

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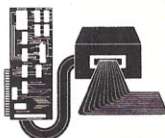
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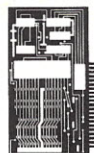
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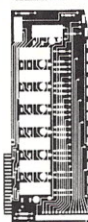
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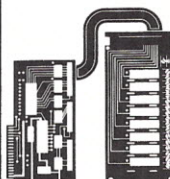
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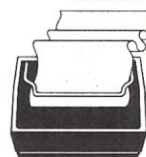
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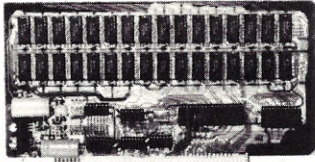
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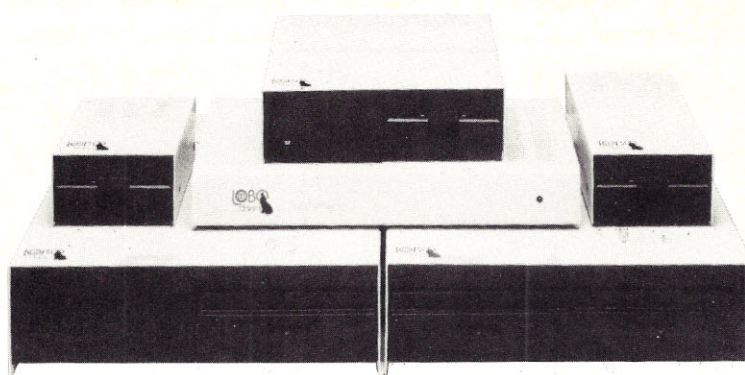
```

4770 PRINT "ITEM ";N4;T$(N4)
4780 ON C(N4) GOTO 4790,4810,4840
4790 INPUT "SEARCH STRING",S$(N4)
4800 GOTO 4900
4810 INPUT "MAX VALUE",S(N4,2)
4820 INPUT "MIN VALUE",S(N4,1)
4830 GOTO 4900
4840 PRINT "LATEST"
4850 GOSUB 1200
4860 LET S(N4,2)=D1
4870 PRINT "EARLIEST"
4880 GOSUB 1200
4890 LET S(N4,1)=D1
4900 NEXT J
4910 REM BEGIN SEARCH OF FILE
4915 LET N5=0
4920 FOR I=1 TO N
4930 LET F=1
4940 GOSUB 1400
4950 FOR I1=1 TO N6
4960 LET N4=B(I1)
4970 ON C(N4) GOTO 4980,5093,5093
4980 REM MATCH STRINGS
4990 LET L=LEN(S$(N4))
5000 LET L1=LEN(A$(N4))
5010 IF L>L1 THEN 5220
5020 LET K=1
5030 IF S$(N4)<>MID$(A$(N4),K,K+L-1) THEN 5060
5040 REM MATCH FOR THIS I1
5050 GOTO 5090
5060 IF K>=L1-L+1 THEN 5070
5063 LET K=K+1
5066 GOTO 5030
5070 REM NO MATCH
5080 GOTO 5220
5090 NEXT I1
5092 GOTO 5100
5093 REM MATCH NUMBER
5094 GOSUB 5400
5095 IF M3=0 THEN 5220
5096 GOTO 5090
5100 REM FULL MATCH ALL ITEMS
5101 REM PRINT RESULTS
5105 LET N5=N5+1
5110 IF N2=8 THEN 5190
5120 LET N3=N1
5130 FOR J=1 TO N1
5140 GOSUB 1700
5150 NEXT J
5170 GOSUB 1800
5180 GOTO 5220
5190 REM PRINT TO DISK
5200 LET F=2
5210 GOSUB 1500
5220 NEXT I
5225 PRINT I
5230 PRINT "END OF FILE ";F$
5240 CLOSE #1
5250 IF N2<>8 THEN 5295
5251 FOR J=1 TO N1
5252 WRITE #2,T$(J),C(J)
5253 NEXT J
5254 WRITE #2,N1,N5
5260 CLOSE #2
5270 PRINT "NAME FOR DESTINATION FILE"
5275 LET O=2
5280 GOSUB 1000
5290 GOSUB 2220
5295 GOSUB 1900
5300 GOTO 200
5400 LET M3=0
5405 REM IF M3=0 THEN NO MATCH
5410 IF A(N4)>S(N4,2) THEN 5440
5420 IF A(N4)<S(N4,1) THEN 5440
5430 LET M3=1
5440 RETURN

```



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8212C	Two SA801 in cabinet w/power
5212	Two SA851 in cabinet
5212C	Two SA851 in cabinet w/power

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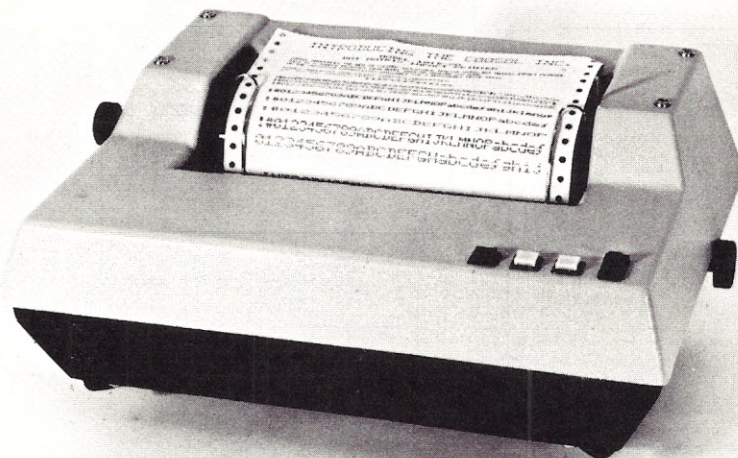
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# A Better Bubble Sort

By W. A. Harrison and S. H. Sachs

**M**any methods to sort record lists are available. The bubble sort—also known as sorting by exchanging—is one of the most common.

When you sort a list of items, you must have one particular field you are sorting by. This field is known as the *sorting key*. For example, assume you are sorting a list of students by age; age would be the sorting key.

When sorting, you try to arrange your list so the values of your keys run from smallest to largest. In the process of sorting this list of items, you must at some time examine or otherwise process every key in the list. This is described as a *pass*. Each time you process the entire list, you perform a pass.

The bubble sort compares each ad-

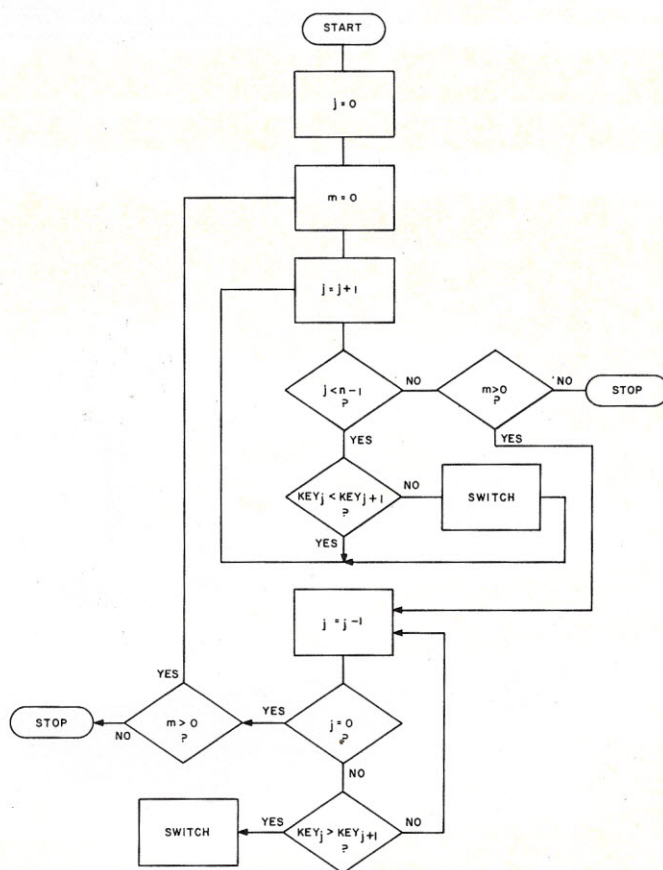
joining pair of keys in the list. If they are in the proper order (i.e., the first key is less than the second key), you compare the next pair of keys in the list (this second pair of keys would include the second key of the previous pair as the first key of this pair).

On the other hand, if they are not in the correct order, you exchange the two keys so that they will be. This is done throughout the entire list. Each time you make a pass, you keep track of the number of exchanges you made. When you find you have made no exchanges, the entire file is sorted. You move the keys to their proper position within the list (as the key is repositioned, the rest of the record is, of course, also repositioned).

The bubble sort is easy to program and understand. Also, the amount of primary storage required is a function of the length of the list and the size of the records. The amount of time used for the sort depends on the length and original order of the list.

The main problem with the bubble sort is that if you have a list of  $n$  items—all in the proper order except for the key of the smallest value, which is at the very end of the list—it will require  $n$  passes to position the key at the beginning of the list where it belongs. This is because the key is only moved forward one place for each pass of the list, since the sort works from left to right.

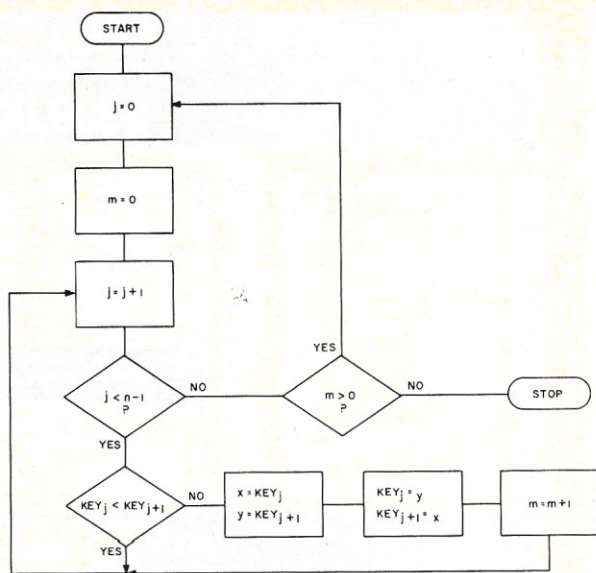
This problem can be eliminated if you make a bidirectional pass. This method goes from left to right on its first pass, just like the single-directional pass, but then makes a pass from right to left on its return. This



Flowchart for one-way bubble sort starts with element counter  $j$  and exchange counter  $m$  at zero. As adjacent pairs of elements are compared,  $j$  is incremented. At the end of each pass, ( $j > n - 1$ )—the exchange counter  $m$ —is checked to determine if an exchange had been made on this pass ( $m > 0$ ). If not, the sort is complete, and the job is terminated; otherwise, control is transferred to the beginning of the flow for another iteration.

Address correspondence to W. A. Harrison, PO Box 1073, Rolla, MO 64501, and S. H. Sachs, 11 Peabody Ter., #1601, Cambridge, MA 02138.

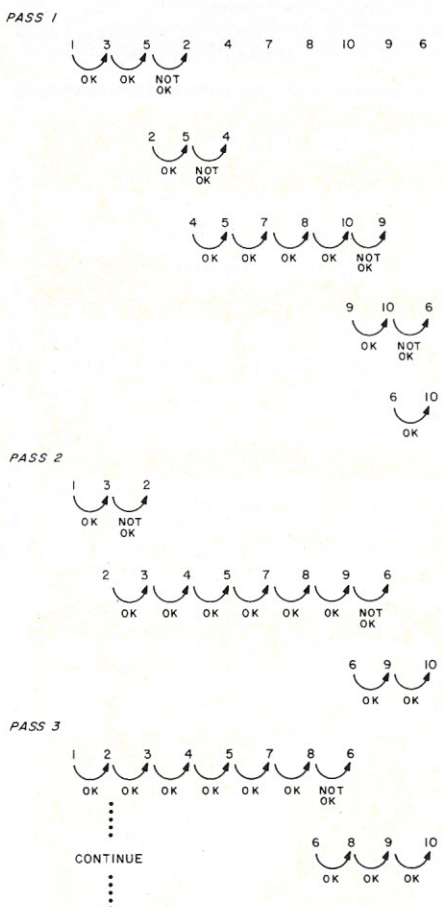




Two-way bubble sort resembles the one-way bubble sort, but instead of beginning the iteration over at the end of one pass, the counter is decremented, and the sort operation takes place in the reverse direction. This method, as the one-way method, checks to determine if the list is sorted by checking the switch counter.

allows the out-of-order key discussed above to be properly positioned after only two passes.

With this modification, the bubble sort is an efficient, yet simple method of sorting an unordered list. ■



One-way bubble sort is easy to understand and efficient, but if an unordered element is isolated in the middle of the list, a number of passes may be required to sort.

Two-way bubble sort proves to be quicker and more efficient than one-way bubble sort, especially when the unsorted element is isolated in the middle or far end of the list.

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# A Bright Star Comes into Focus

By William L. Colsher

In the short time that I've had my Atari 800, I've accumulated the usual assortment of nitpicks. I've also come away feeling pretty good about the system. It should give Apple and Radio Shack a run for their money.

## What You Get

Once you've paid your money, what do you take home? With the Atari 800 you get an 8K, 6502-based home computer that includes a 10K operating system ROM cartridge, a BASIC ROM cartridge and an Educa-

tional System ROM cartridge. The price of the 800 also includes the Atari 410 Program Recorder (extra with the model 400 computer). For documentation you have the 332-page book *Atari BASIC* plus another 30-odd pages of operator's manuals. A cassette titled "An Invitation to Programming" wasn't quite ready when I got my system but should be packed with each computer by the time you read this.

The basic Atari 800 costs about the same as a 16K Apple II or a 16K Level

II TRS-80. (These are all list prices—you may be able to get a better deal elsewhere.) You might think that Atari's memory prices are way out of line. But you're getting more than the eight simple chips an Apple or TRS-80 uses. If you compare the prices of S-100 16K memory boards, Atari's prices come into better focus. For example, a Godbout 16K Econoram IV costs \$289 in "unkit" form (you plug in the chips). (See the hardware photos.)

Disk drive and printer prices are way out of line—sort of. *Everything* that Atari makes to connect with their computer (except joysticks) interfaces by way of a *serial* connector on the side of the console (look at the hardware photos again). You start off with the 410 tape recorder and daisy chain your printer, disks and so on. This means that every peripheral, even a printer that costs \$250 somewhere else, has to be smart. The processor and support circuitry end up costing as much as the peripheral itself.

The documentation is rather strange. That 332-page book is not really a reference manual. In fact, it is a programmed instruction manual similar to the Level I Radio Shack manual. It can be used as a reference but it is far, far from complete. (To Atari's credit there is another manual—the *Atari BASIC Reference Manual*

Address correspondence to William L. Colsher, 4328 Nutmeg Lane, Apt. 111, Lisle, IL 60532.

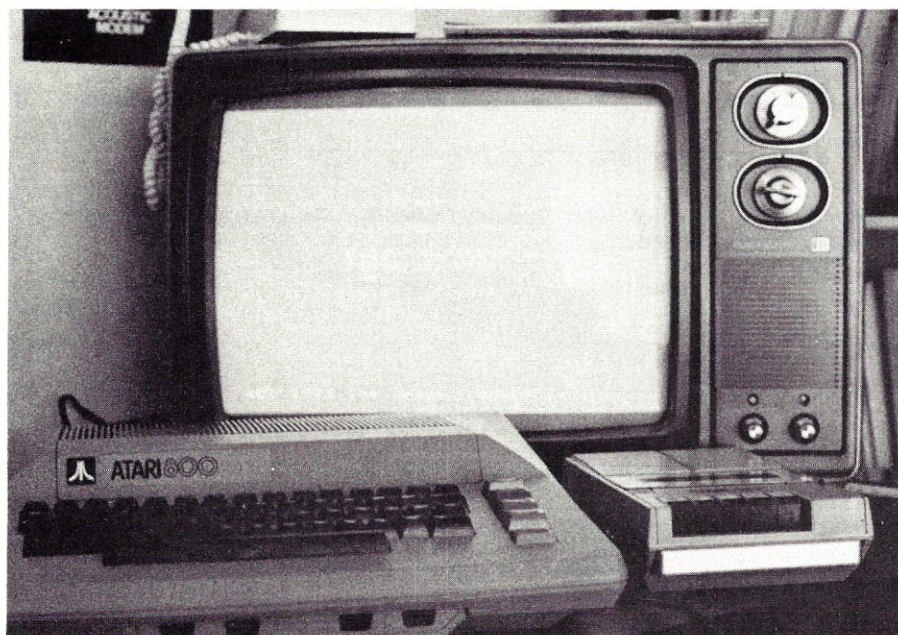


Photo 1. The Atari 800. Note the game controller ports under the keyboard, Atari 410 Program Recorder to the far right. Program on screen is from Sears Program Library.



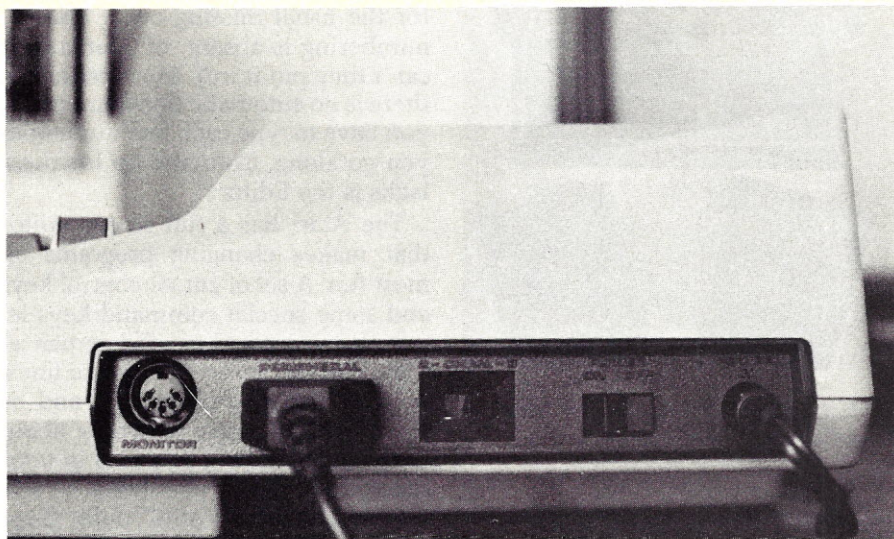


Photo 2. On the right side of the console are (from left to right): color monitor output, peripheral port [everything Atari makes goes through this connector], TV channel selector, power switch, and power cable. Like the TRS-80, the Atari computers use an external transformer.

—that you can get by sending in your warranty card. Mine's been in a month and I still haven't heard anything.)

The version of BASIC supplied is pretty standard. It includes the usual features such as floating point math and strings, plus new keywords for the special Atari features. There are five keywords for graphics, four for the hand controllers (joysticks or paddles), the SOUND keyword to control four-voice music or sound effects and a few more undocumented ones that I haven't been able to figure out.

While I'm on the subject of undocumented features, look at Table 2. By snooping around a little and making some educated guesses I came up with a list of keywords and functions that aren't mentioned in *Atari BASIC*. (If you'd like to snoop around a little try out Program 1. It's a refined version of the one I used to explore my new 800's ROMs.)

I only have one other complaint, about the keyboard. When I started to use my system, the keyboard had a familiar feel. So I pried off a keycap. Sure enough: little gold fingers. The Atari design seems to be a bit different than Radio Shack's, though. The fingers come together by themselves when you take off the keycap. Radio Shack's are pushed together. In addition, you get audio feedback with each keypress. (A cute little beep that slowly turns into a perfectly hideous little beep as you type in long programs.) I haven't had any trouble with keybounce (yet) so hopefully Atari learned the Radio Shack key-

board lesson and did it right the first time.

After all this complaining I should mention some of the little things Atari put in that nobody else seems to have thought of. With the standard display you get 24 lines of 38 characters. If you have a monitor or a perfectly adjusted TV set you can change the width to 40 characters, or lower it to 36 characters if your TV is poorly

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Table 1. List prices.



Photo 3. Cover off—two ROM cartridge slots in the front section and four slots for ROM and RAM expansion to the rear. Note the heavy metal shielding. Now you know how Atari passed the FCC tests.

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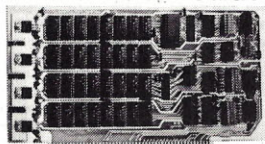
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Photo 4. A RAM card and the two ROM cartridges that come with the system.

adjusted. Just a couple of pokes do it. The system reset key is well off to the side and doesn't blow your program when you hit it. You have to type NEW to do that. There are probably other things that are so obvious I haven't noticed them.

## Atari BASIC

Atari BASIC is a good, though smallish, version of the language. It has enough nice features to make up

for the usual missing ones. Line renumbering is absent, of course (*why* can't they put it in?). More seriously, there is no automatic line numbering; you have to type each line number as you go along. To make up for these lacks is the Editor.

The Atari has a full screen editor that makes changing programs almost fun. A set of cursor control keys and some special command keys let you move around on the screen at will. You can insert and delete lines, erase extraneous characters and so on. You don't have to worry about extra blanks taking up room in your system either—if you leave a few here and there, BASIC pulls them out. (It will also insert spaces between keywords to improve readability when you LIST a program.)

You can use abbreviations with this BASIC (which makes up for having to type in the line numbers). They aren't documented but since a few are mentioned in the *Atari BASIC* book I thought I'd look for some more. Table 3 is the list of keyword abbreviations I've been able to find.

ADR	
CLOG	Log. base 10
CLOSE	
CLR	Frees all dimensioned space and sets scalars to zero
COM	Common area to share between programs? (ala FORTRAN COMMON)
CONT	Continue after a "STOP"
DEG	Tell next trig. function to expect degrees.
DOS	
ENTER	
GET	
LOAD	
LOCATE	
LPRINT	Obvious
NOT	Logical operator—n=0: NOT n=1, n≠0: NOT n=0
NOTE	
OPEN	
PADDLE	Control game paddle
PEEK	The usual
POINT	
POKE	The usual
POP	
POSITION	Place the cursor at a specific position—ex. POSITION 10,5 puts cursor at location 10 of line 5
PTRIG	Game paddle trigger
PUT	
RAD	Tell next trig. function to expect radians—default
RAND	
SAVE	
STATUS	
STICK	Control joystick
STRIG	Joystick trigger
TRAP	
USR	User machine language functions?
XIO	Direct Input/Output control?

Table 2. Keywords and functions they didn't tell us about.





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**EXECUTE<sup>BS</sup> SCROLL<sup>ed</sup> OUT<sup>ed</sup> SET<sup>ed</sup> SEND<sup>BS</sup> PRINT USING<sup>BS</sup> BEEP<sup>BS</sup>**

```
100 GOSUB 180
105 PRINT USING CS, A, BS
130 INPUT "TIME", DS
131 INPUT "DAY", ES
160 IFB - C THEN 105
180 FOR X=IT09
183 PRINT Y(X):NEXT
184 RETURN
200 I=X/19
READY
RENUMBER 110, 10, 105-184
READY
LIST
100 GOSUB 150
110 PRINT USING CS, A, BS
120 INPUT "TIME", DS
130 INPUT "DAY", ES
140 IFB - C THEN 110
150 FOR X=IT09
160 PRINT Y(X):NEXT
170 RETURN
200 I=X/19
READY
```

```
MERGE D1 "BUY NOW"
SEARCHING FOR BUY NOW
LOADING
READY
RENUMBER 100, 10
READY
FIND BS
110 PRINT USING AS, BS, BS + CS + DS
280 BS="NOW IS THE TIME"
READY
```

```
580 BA=BA-1
590 RA=123*5X/92-BA*10
600 IF BA=143 THEN 580
610 RETURN
620 CS="PROFIT $#, #### DAILY"
630 PRINT USING CS, PI
640 DS="LOSS $#, #### DAILY"
650 PRINT USING DS, LI
RUN
PROFIT $1, 238.61 DAILY
LOSS $ 0.00 DAILY
READY
```

```
180 FOR A=4096TO8191:POKEA, B:B=B-1:PRIN
T B:IFB <255 THEN B=B-255:PRINT B
TRACE
```

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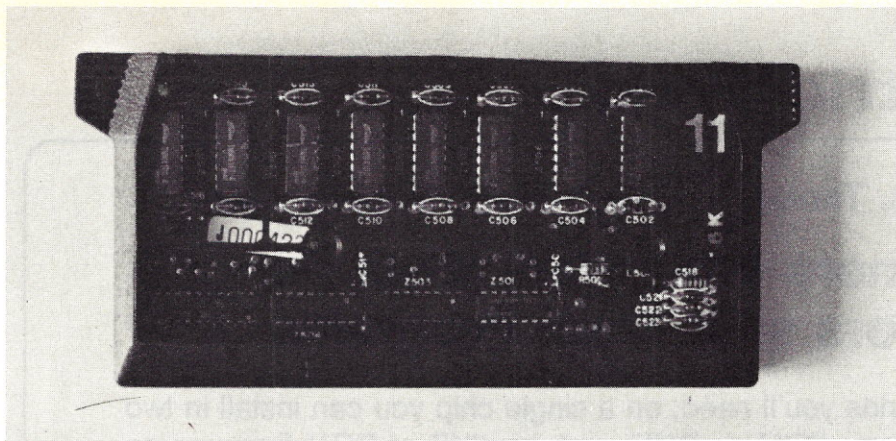


Photo 5. Inside a RAM card. Just your regular 16K dynamics.

If you use a keyword or abbreviation when typing in a program, BASIC translates it to an internal form. When you LIST the program you get the *whole* keyword rather than the short form. This is another aid for getting readable programs from what you type in.

One of the very nicest features of this version of BASIC is one I've never seen before. If you make a mistake while typing in a BASIC program, the

computer will tell you right away with the cursor at the point the error was detected. Since you have a terrific screen editor you can just go back to your original statement, make the changes and continue.

As you may know from reading the advertisements, this computer has nice graphics. Here are some you may not know about. The keyboard is full upper and lowercase. (In fact, the keyboard looks a whole lot like a

Keyword	Abbreviation
COLOR	C.
CSAVE	CS.
DATA	D.
DRAWTO	DR.
FOR	F.
GOSUB	GOS.
GOTO	G.
INPUT	I.
LIST	L.
LPRINT	LP.
NEXT	N.
PLOT	PL.
PRINT	?
REM	R.
RESTORE	RES.
RETURN	RET.
SETCOLOR	SET.
SOUND	SO.

Table 3. Keyword abbreviations.

standard *terminal* keyboard. It even has square brackets. I think somebody had timesharing in mind when this machine was designed.) Then there are the 29 keyboard graphics characters that you can use with

## Hidden Features Exposed

By Jerry Blank

The Atari has gotten far less recognition than it deserves. It has the program-editing features of expensive terminals, eight built-in A/D converters, selectable channel 2 or 3 rf output and hi-res graphics capabilities to match those of the Apple II. Unlike the Apple, however, Atari has a very decent and thorough BASIC, with 10K operating system support and disk commands to boot. Atari BASIC's one minor flaw, perhaps, is the absence of user-defined functions and string arrays.

But Atari users have one major complaint—the *Atari Reference Manual* is vague about the use of the 410 Program Recorder for data table storage.

Address correspondence to Jerry Blank, RR1 N, Box 71B, Williston, ND 58801.

### Software Modifications

Atari users are probably aware that the I/O commands PUT and GET are useful in screen graphics. In addition, these commands can be used to access other parts of the computer. In the statement  
OPEN #2,12,0,"S"  
I/O port 2 is reserved for the screen ("S"). The letter within quotes can be changed, defining a different part of the computer. In the case of the Program Recorder, this letter is "C." Therefore, access to the cassette can be obtained with the following statement:

```
OPEN #N,12,0,"C"
```

N can be any I/O port from 2 through 6, provided the user has not reserved other ports with previous OPEN statements. A typical routine

to save an array on tape looks like this:

```
10 OPEN #2,8,0,"C"
20 PRINT "Press any key to start tape."
30 FOR I= 1 TO 100
40 PUT #2, A(I)
50 NEXT I: CLOSE #2
60 ?"Data saved."
```

To recover the data, use the same routine but change the following lines:

```
10 OPEN #2,4,0,"C"
40 GET #2,X: A(I)=X
60 PRINT "Data loaded."
```

The cassette motor will operate automatically, but make sure the play and record buttons are pressed as necessary. Also, you might need to advance the tape past the leader at the beginning of the cassette.

Along with cassette file saving, there are many other interesting and useful POKE locations. For example, if you have tried printing some of the Atari graphics characters, you will know that some characters must be preceded with "ESC" to be printed, which can be downright inconvenient. This little problem can be solved by poking 1 into memory location 766. But doing this will disable all the fancy editing functions, so



```

10 PRINT "42159 TO 42494"
20 FOR I=42159 TO 42494
30 PRINT CHR$(PEEK(I));
40 NEXT I
50 PRINT :PRINT "42986 TO 43133"
60 FOR I=42986 TO 43133
70 PRINT CHR$(PEEK(I));
80 NEXT I
90 END

```

*Program 1. This particular "snooper" displays the Atari 800's BASIC keyword tables. This is a good way to check up the completeness of the documentation supplied with a computer. To get a polished snooper like this you have to start with location zero and just let it run until you see something interesting on the screen. Then you fine-tune to display just what you want to look at.*

PRINT statements. As you can see from Photo 6 all this is available in reverse video as well.

Atari BASIC documents six graphics modes. As you can see from Table 4 I've been able to figure out nine. I can understand not putting Mode 8 in a general-purpose book sent out with 8K systems, since that mode requires

more than 8K for the screen memory. (The Atari 400 computer can only have 8K so it can never use Mode 8.)

Atari BASIC states that a "complete color graphics program must have the three statements: GRAPHICS, COLOR and SETCOLOR." Well, GRAPHICS is used to set the mode. That's pretty easy to understand. COLOR is used to turn on the "color machine," though it is never really explained. I've discovered some other uses for it as well. SETCOLOR is never fully explained. It is the most complicated of the three statements and could use better coverage. Frankly, I don't understand it at all. There isn't much information in the book and the instruction seems to work differently with different graphics modes. Program 2 is a simple demonstration of the Atari's color graphics. Its output is shown in Photo 7. What you can't see in the picture is that after each execution of the SETCOLOR statement all the points that have been plotted change to the new color.

The secret to getting more than one color on the screen at once seems to lie in the use of the COLOR state-

ment. But it's not mentioned exactly how to do this. Here's what seems to happen:

- With COLOR 0 all points plotted are the same as the background color (i.e., they're invisible—an erase function).
- With COLOR 1 all points change color when a SETCOLOR 0,c,1 is exe-



Photo 6. The Atari character set.

when you're through printing control characters, load location 766 with 0.

In graphics modes 1 and 2, it is only possible to display uppercase and numbers/punctuation, or lowercase and special characters—not both at one time. To obtain uppercase in these modes, poke 224 into location 756. To get lowercase characters, poke 226.

In some Atari arcade games using the same graphics chip as the 400/800, the display is a mirror reflection of the CRT—a clever space-saving technique. To make a right-reading image in the mirror, the CRT must display a reverse mirror image. You can get this mirrored video effect by poking 4 into location 755. To restore normal video, poke 2 into location 755.

In some programs, particularly games, it may be advisable to turn off the cursor, by changing the contents of memory location 752 from 0 to 1.

If you wish to start the cassette motor remotely, poke 52 into location 54018. To turn the motor off, poke 60 into the same location.

One interesting feature of the Atari is the real-time clock, located at memory addresses 18, 19 and 20.

This clock is updated every 1/60 of a second. Here is a simple 24-hour clock program that implements the real-time feature:

```

10 GRAPHICS 0: PRINT "Set hours/ minutes
seconds"; INPUT H,M,S
20 A=INT(((H*3600) + (M*60) + S)*60):
B=INT(A/65536):C=INT((A-(B*65536))/
/256):D=A-(B*65536)-(C*256)
30 GRAPHICS 0: POKE 18, B: POKE 19,C:
POKE 20,D
40 A=INT(((PEEK(18)*65536) +
((PEEK(19)*256 + PEEK(20))/60):
B=INT(A/3600):C=INT(A-(B*3600)):
D=A-(B*3600)-(C*60)
50 POSITION 2,0: PRINT B;" ":"C;" ":"D;" "
60 GOTO 40

```

To modify this program to reset hours at midnight or to have a selectable 12/24-hour mode, only minor changes are needed.

### Hardware Modification

Owners of 8K Atari 400s soon find out that 8K is not nearly enough user memory, especially when using 160 × 80 four-color graphics. In fact, it is impossible to use the high-resolution 320 × 160 graphics with a minimal 8K system. Unfortunately, the Atari 400 has no provision for direct memory expansion. The 8K memory card may

be replaced with a 16K board at an approved regional service center, but this is time-consuming and costly.

You can upgrade your Atari 400 to 16K using this method:

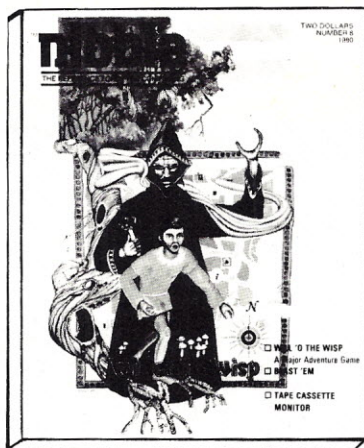
- Disassemble an Atari CX853 16K memory cartridge.
- Remove the PC board inside and discard the plastic case and screws.
- Remove the Atari 400's cover and metal rf interference shield.
- There are two printed circuit cards plugged into the main board just behind the ROM cartridge slot. The front-most board is the 8K memory board, and is identical with its 16K replacement. Simply replace the board with the one taken from the CX853 cartridge, reassemble the computer and turn it on.

There should now be 13,326 bytes free. Keep in mind that servicing an Atari computer yourself is a violation of the 90-day warranty.

It seemed to me that the 16K board was merely an 8K board with 16K chips, and the two discrete resistors near the edge connector clipped off. I didn't try to directly modify my 8K board, though; it is easier, although more expensive, to plug in a new board. ■



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cuted (c is the color and 1 is luminance).

●With COLOR 2 all points change color when a SETCOLOR 1,c,1 is executed.

●With COLOR 3 all points change color when a SETCOLOR 2,c,1 is executed.

So it's actually possible to have three colors, plus the background color, on the screen at once.

If you take a look at Table 4 again you'll notice that graphics modes 1 and 2 display letters. To use this feature you need the COLOR and PLOT statements. In COLOR you use the ASCII value of the character you want to use and then PLOT at the position you want it to appear. With a little fooling around it turns out you can get these letters in four different colors as well.

In addition to the PLOT command, Atari has supplied a command called DRAWTO. It does exactly what you would expect it to: it draws a line from the point you're at to the one you specify. Of course, you have to use a PLOT or previous DRAWTO so the computer has a place to start. (Actually, the computer will try to draw a line for you but the results will be unpredictable if you haven't given it

```
10 GRAPHICS 7
20 COLOR 1
30 FOR C=0 TO 15
40 SETCOLOR 0,c,10
50 GOSUB 1000
60 NEXT C
70 STOP
1000 FOR TH=0 TO 6.28 STEP .1
1010 X=SIN(TH)*20+20+C*5
1020 Y=COS(TH)*20+20
1030 PLOT X,Y
1040 NEXT TH
1050 RETURN
```

Program 2. The program to produce Photo 7.

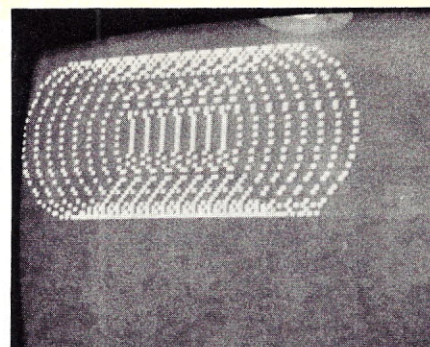


Photo 7. Mode 7 graphics. The highest resolution available on a minimum system.

a starting point.)

A couple of years ago it was a big deal to toggle an output bit to make music. Then came some simple boards that improved on that technique a little. Now we have a four-voice synthesizer in a \$1000 personal computer.

The tone quality is excellent. There are 256 possible notes, which range from just barely audible (inaudible to some people) at the high end to about an octave below middle C.

Using the SOUND feature is also easy. Atari BASIC contains a table of "computer notes" (0 to 256) and "musical notes" (D#, C, F, etc.). You don't have to play just music, of course. By playing with the tone parameter, you can get some pretty strange effects. Interestingly, only the even tones (0,2,4,8, etc.) produce any sound.

Obviously, the possibilities here are pretty wide. I've come up with a few ideas for strange, science-fiction sounds in Program 3. You can play regular music with chords and a melody, since once you turn on a note with the SOUND statement it doesn't go off until you turn it off.

Games improved when we got graphics with our computers. I think they'll improve some more now that sound is easy and standard. The edu-

Mode	Overhead	Resolution or Result
0	3058	Regular screen
1	2740	Double wide letters and 4 line window at bottom
2	2490	Double wide & double high letters and 4 line window
3	2500	39x20 and 4 line window.
4	2760	79x40 .. ..
5	3240	79x40 .. ..
6	4240	158x80 .. ..
7	6256	158x80 .. ..
8	10178	320x192 .. ..

Table 4. Graphic mode overhead.



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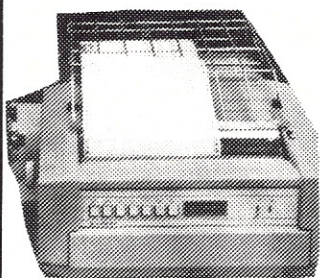


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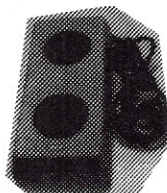
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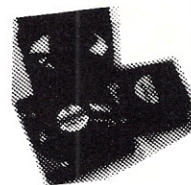
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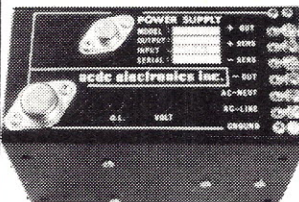
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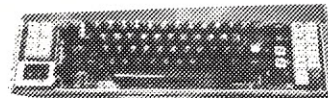
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```

10 REM ***LISTEN TO A SINE WAVE
20 FOR TH=0 TO 3.1415 STEP .1
30 N=125*ABS(SIN(TH))
40 SOUND 0,N,10,8
50 NEXT TH
100 REM ***PHASER FIRE
110 FOR N=20 TO 40
120 SOUND 0,N,10,8
130 NEXT N
200 REM ***BATTLE CRUISER
    ZOOMING BY
210 FOR V=0 TO 15
220 SOUND 0,25,16,V
230 FOR I=1 TO 20:NEXT I
240 NEXT V
250 FOR V=15 TO 0 STEP -1
260 SOUND 0,25,16,V
270 FOR I=1 TO 20:NEXT I
280 NEXT V
999 END

```

Program 3. Some interesting sounds.

cational possibilities are interesting, too. With an accurate note source built into the computer, instruction in music theory and even elementary instrumental training are possible. (As a matter of fact, I'm working on

Since this article was written a number of things I mentioned are no longer true and some of my predictions have proven accurate. First: the Atari *BASIC Reference Manual* is now packed with each system. It is an excellent manual for the experienced programmer and the beginner will be able to use it as soon as he finishes the *Atari BASIC* book. Prices have gone up. The Atari 800 now retails for about \$1080, but it includes 16K of memory rather than 8K and the 410 tape recorder is extra.

A number of companies have entered the add-on market and at least one offers a 16K add-on for \$119.50 and a 32K (!) board for \$320. The possibilities opened by the 32K board are quite interesting since it leaves one memory slot completely free. There are also several printer interfaces available that make use of the game ports, and software is becoming increasingly easy to find.

an elementary guitar course right now.)

### Conclusions

Would I still buy an Atari? Yes, I think so. My major complaint was about the documentation—I think that Atari went a little too far in supporting the beginner at the expense of the experienced programmer. I am concerned about possible problems when running all peripherals daisy-chained. For example I have read that the disk has a transfer rate of 48,000

bps. My MPI disk drive manual says the drive is capable of handling up to 250,000 bps. That doesn't seem like very efficient use of a rather expensive peripheral.

I have faith in this industry, though. If the Atari becomes popular enough people will come out with add-ons that use the memory board slots rather than the peripheral port on the side of the machine. I anticipate that with the great potential of this machine, it won't be long before we see those add-ons. ■

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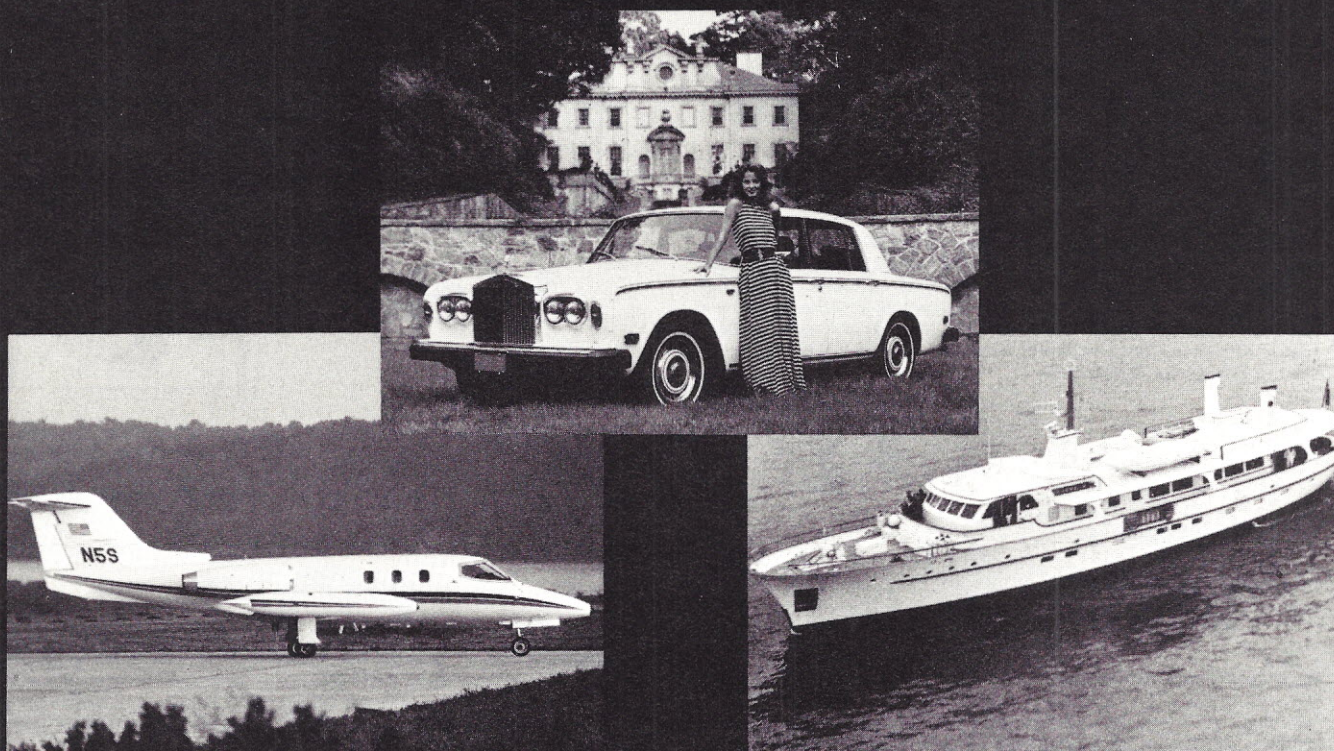
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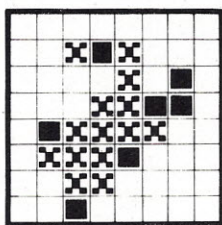
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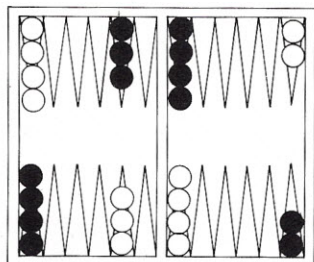
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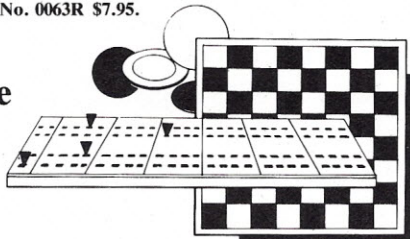
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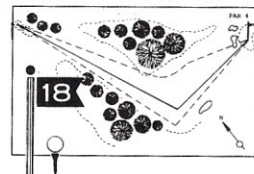
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# Sorta Super Fast

By Albert J. Marino

**T**his program will let you sort 32K in one minute. This means you can sort 2000 names in one minute and, in fact, can sort 10,000 names in a reasonable time. The routine can

easily be used with any BASIC or other language as long as it supports external (user) routines and has a POKE or similar function.

I originally wrote a machine lan-

guage program that worked on the algorithm shown in Fig. 1. This routine was short and simple, required no scratch space and was about four times faster than a modified bubble sort. I have never seen this algorithm implemented by anyone else and it might be unique; it certainly is good enough for most applications.

However, when the files reached 2000 names, I found that this routine was taking two to three minutes. Since the time for the routine is approximately a function of  $N^2$ , this meant that 10,000 names would take over an hour. I decided I needed a better routine.

Listing 1. 8080 assembly-language Shell-Metzner sort.

```

1:
2:
3:
4:
5:
6:
7:
8:
9: AB00 .      orig      org      0ab00h ;change this for dif loc
10: AB00 =      n1:      equ      orig
11: AB02 =      m1:      equ      n1+2
12: AB04 =      k1:      equ      m1+2
13: AB06 =      j1:      equ      k1+2
14: AB08 =      i1:      equ      j1+2
15: AB0A =      m11:     equ      i1+2
16: AB0C =      dj1:     equ      m11+2
17: AB0E =      di1:     equ      dj1+2
18:
19: AB00        ;        ds        16
20:
21: AB10 2A06AB ;        lhld      j1      ;get st adr
22: AB13 E5     ;        push      h        ;save
23: AB14 2A04AB ;        lhld      k1      ;get length
24: AB17 E5     ;        push      h        ;save
25: AB18 AF     div:     xra        a        ;m1=m1/2
26: AB19 2A02AB ;        lhld      m1
27: AB1C 7C     ;        mov       a,h
28: AB1D 1F     ;        rar
29: AB1E 67     ;        mov       h,a
30: AB1F 7D     ;        mov       a,l
31: AB20 1F     ;        rar
32: AB21 6F     ;        mov       l,a
33: AB22 2202AB ;        shld      m1      ;save new m1
34:
35: AB25 B4     ;        ora        h        ;check if done
36: AB26 C22CAB ;        jnz         ndon
37: AB29 C1     ;        pop        b        ;done, return
38: AB2A D1     ;        pop        d
39: AB2B C9     ;        ret
40:
41:
42:
43: AB2C EB     ;        ndon:     xchg      ;m1 to de
44: AB2D 2A00AB ;        lhld      n1
45: AB30 7D     ;        mov       a,l
46: AB31 93     ;        sub       e
47: AB32 6F     ;        mov       l,a
48: AB33 7C     ;        mov       a,h
49: AB34 9A     ;        sbb        d
50: AB35 67     ;        mov       h,a
51: AB36 2204AB ;        shld      k1

```

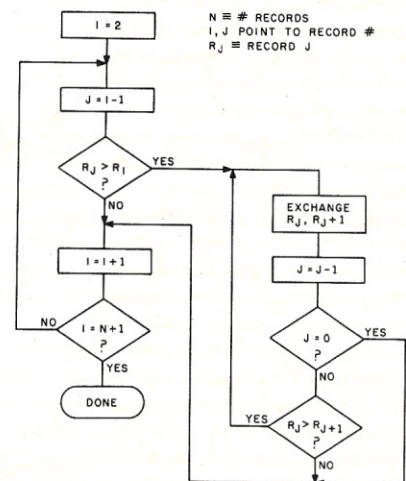


Fig. 1.

Address correspondence to Albert J. Marino, Compleat Systems, 9551 Casaba Ave., Chatsworth, CA 91311.

More



The one I settled on was the Shell-Metzner sort shown in Fig. 2. Listing 1 shows the 8080 assembly-language program for this sort. Of course, the program will work for any 8080- or Z-80-based computer. The listing happens to be assembled at location AB00H but can be reassembled for any starting address. Note that the routine takes 203 bytes, including the 16-byte scratch area at the beginning.

### Using the Routine

Once the program is in memory, it can be used by any other program, as long as it is not overwritten. To use it follow these steps:

- Put the records to be sorted into memory starting at any location and sequentially up in memory. The records must be the same length.

- Put the number of records to be sorted in location n1 (AB00H in our listing) and also in location m1 (AB02H). Note that the numbers are 16-bit (two-byte) numbers and are stored in standard reversed format with low byte first and high byte second. For example, if the number of records is 4000 (=0FA0H) then 160 (A0) is put into location AB00H and 15 (0F) is put into location AB01H.

- In like manner, put the length of each record into location k1 (AB04,5) and the starting address in location j1 (AB06,7).

- Transfer control to the program (call) at location ORG + 16 (AB10H).

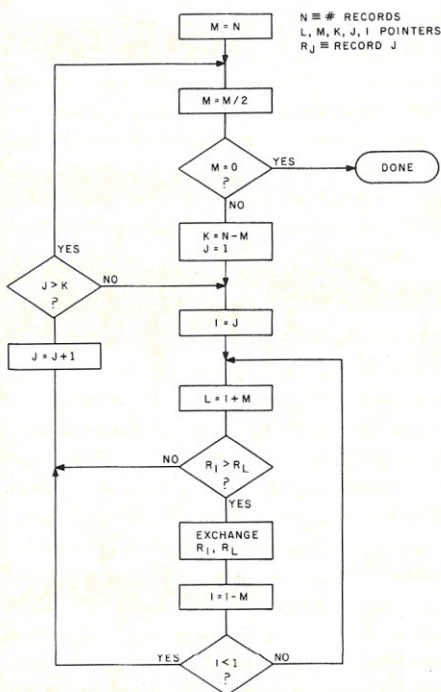


Fig. 2.

Listing 1 continued.

```

52:      ;
53:      AB39 210100      ; lxi h,1      ;set & save i=j=1
54:      AB3C 2206AB      shld j1
55:      AB3F 2208AB      shld i1
56:      ;
57:      ;calcl & save addr offset = m1*11
58:      ;
59:      AB42 2D          dcr l
60:      AB43 C1          pop b      ;len of str=11
61:      AB44 C5          push b
62:      AB45 19          dad d
63:      AB46 0B          dcx b
64:      AB47 78          mov a,b
65:      AB48 B1          ora c
66:      AB49 C245AB      jnz lp1
67:      AB4C 220AAB      shld m1
68:      ;
69:      AB4F EB          xchg      ;calcl & save d(j), d(i), d(i+m)
70:      AB50 C1          pop b
71:      AB51 E1          pop h
72:      AB52 E5          push h
73:      AB53 C5          push b
74:      AB54 220CAB      shld dj1
75:      AB57 220EAB      shld di1
76:      AB5A EB          xchg
77:      AB5B 19          dad d
78:      AB5C EB          xchg      ;hl has d(i), de has d(i+m)
79:      ;
80:      ;compare strings & switch
81:      ;
82:      AB5D C1          cp1:      pop b      ;len of string=11
83:      AB5E C5          push b
84:      AB5F 1A          ldax d      ;compare ea byte
85:      AB60 96          sub m
86:      AB61 C26FAB      jnz neq
87:      AB64 23          inx h      ;if = compare next byte
88:      AB65 13          inx d
89:      AB66 0B          dcx b
90:      AB67 78          mov a,b
91:      AB68 B1          ora c
92:      AB69 C25FAB      jnz lp3
93:      AB6C C3ABAB      jmp nsw      ;if done, don't switch
94:      ;
95:      AB6F D2ABAB      neq:      jnc nsw      ;if d(i)<d(i+m) don't sw
96:      ;                          ;change to jc for descending
97:      ;
98:      AB72 C5          sw:      push b      ;sw bytes not =
99:      AB73 46          mov b,m
100:     AB74 1A          ldax d
101:     AB75 77          mov m,a
102:     AB76 78          mov a,b
103:     AB77 12          stax d
104:     AB78 23          inx h
105:     AB79 13          inx d
106:     AB7A C1          pop b
107:     AB7B 0B          dcx b
108:     AB7C 78          mov a,b
109:     AB7D B1          ora c
110:     AB7E C272AB      jnz sw
111:     ;
112:     ;str switched, ck if i1-m1<1
113:     ;
114:     AB81 2A02AB      lhld m1
115:     AB84 7C          mov a,h
116:     AB85 2F          cma
117:     AB86 57          mov d,a
118:     AB87 7D          mov a,l
119:     AB88 2F          cma
120:     AB89 5F          mov e,a
121:     AB8A 2A08AB      lhld i1
122:     AB8D 19          dad d      ;if i1-m1<1 then JUMP to same
123:     AB8E D2ABAB      jnc nsw      ;as no switch
124:     ;
125:     ;calcl new d(i), d(i+m)
126:     ;
127:     AB91 23          inx h      ;save new i1=i1-m1
128:     AB92 2208AB      shld i1
129:     AB95 2A0EAB      lhld di1      ;old d(i)=new d(i+m)
130:     AB98 EB          xchg
131:     AB99 2A0AAB      lhld m1      ;addr offset
132:     AB9C 7B          mov a,e      ;new d(i)=old d(i)-offset
133:     AB9D 95          sub l
134:     AB9E 6F          mov l,a
135:     AB9F 7A          mov a,d
136:     ABA0 9C          sbb h
137:     ABA1 67          mov h,a
138:     ABA2 220EAB      shld di1      ;save new d(i)
139:     ABA5 C35DAB      jmp cp1      ;goto compare strings
140:     ;
141:     ;ck for J>k
142:     ;
143:     ABAB 2A06AB      ns:      lhld j1
144:     ABAB 23          inx h      ;save new j=old j+1
145:     ABAC 2206AB      shld j1
146:     ABAF 2208AB      shld i1
147:     ABB2 EB          xchg
148:     ABB3 2A04AB      lhld k1
149:     ABB6 7D          mov a,l
150:     ABB7 93          sub e
151:     ABB8 7C          mov a,h
152:     ABB9 9A          sbb d
153:     ABBA DA18AB      jc div      ;if J>k goto beginning divide m1
  
```

More →



# Listing 1 continued.

```

154:          ;
155:          ;calc new d(j), d(i)
156:          ;
157:  ABBD 2A0CAB      lhl d    dj1
158:  ABC0 D1          pop     d
159:  ABC1 D5          push    d
160:  ABC2 19          dad     d      ;new d(j)=old d(j+1)
161:  ABC3 EB          xchg     m11   ;addr offset
162:  ABC4 2A0AAB      lhl d
163:  ABC7 EB          xchg
164:  ABC8 C354AB      jmp     lp2

```

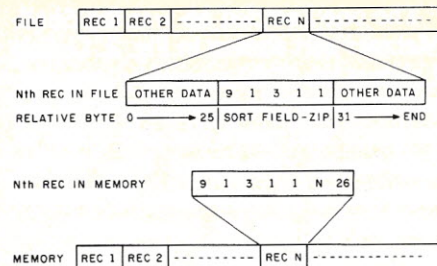


Fig. 3.

The program will then sort the records in ascending order and return.

●To sort in descending order, change the byte at location ORG+6FH (AB6FH) from D2 to DA before calling the program.

## Test Results

To give times for comparison, I filled my memory with a random pattern of 0s and 1s. This minimum number of values for each location results in the maximum times for sorting. Test results are shown in Table 1a. The results for some of the same tests using the original algorithm are shown in Table 1b. The improvement is significant especially for large numbers since the new algorithm time is approximately a function of  $N \log(N)$ .

## An Example

In general, a good technique to use is:

- For each record, load the field to be sorted into memory with a pointer. Fig. 3 shows a typical example.
- Sort using the routine given here.
- Use the now sorted pointers to access each record, in order.

As an example, suppose you want to do an alphabetical sort of names stored in a file in ASCII format (this is

the normal string and file format of most languages). Getting the correct results is not difficult, but it does require some care. Consider the following correctly sorted names:

de la Fleur, Conrad  
Diebold, Tom  
DiGeorge, Olaf  
DiGeorge, Dick  
di George, Len  
Di George, Pete  
Dillingham, Sam

If you had sorted these names by just loading last name first name, into memory, you would have gotten:

Di George, Pete  
DiGeorge, Olaf  
DiGeorge, Dick  
Diebold, Tom  
Dillingham, Sam  
de la Fleur, Conrad  
di George, Len

To get around this problem, make the following changes as the names are loaded into memory for sorting:

- Convert all characters to lowercase (or uppercase).
- Remove all spaces and punctuation in the last name.
- Insert a delimiter between last name and first name with ASCII value lower than letters (I used a comma).
- Truncate this string plus the point-

er to 16 bytes or pad with blanks if shorter.

For example, de la Fleur, Conrad, becomes "delafleur,conxx" and Jones, Sam, becomes "jones, sam0000xx," where xx is the pointer and the 0's are blanks. This allows 14 letters to sort on. With over 6000 names, I have not had a mistake caused by this length restriction; with less names you might get by with even less.

After you've done the above and sorted using this routine, you can use the now-sorted pointers to access the original records in alphabetical order.

## Large Files

If the file is too large to be loaded into memory, even using the above method of loading only the sort field, then you need an additional technique. One method, if you don't know anything about the distribution of the field you're sorting on, is:

- Read into memory as above, stopping when you have filled memory.
- Sort this block 1 and save on disk.
- Read more fields in, sort and save as block 2, 3, etc.
- Merge the blocks by reading each block item by item and saving the appropriate entry on disk in a separate file. This works since each block is individually sorted.

This method works for files of any size, even ones that span multiple disks.

## Conclusion

The sorting routine given here should let you sort your files on any field within a reasonable time. For those who wish, this program is available on a CP/M eight-inch disk or TRS-80 five-inch disk for \$15 from Compleat Systems, 9551 Casaba Ave., Chatsworth, CA 91311 (213-993-1479).

The disk also contains a Z-80 version that takes 25 percent less space and runs 25 percent faster, and two additional utilities (search and move).■

AMOUNT OF MEMORY	# RECORDS	# BYTES/REC	TIME TO SORT SECONDS
16K	4K	4	22
16K	2K	8	22
16K	1K	16	15
32K	8K	4	65
32K	4K	8	75
32K	2K	16	54
32K	1K	32	34

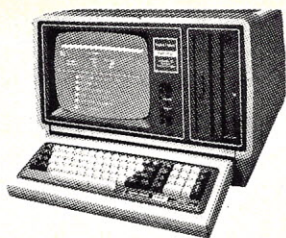
Table 1a.

16K	4K	4	775
16K	2K	8	285
16K	1K	16	110

Table 1b.



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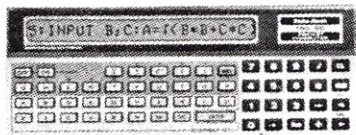
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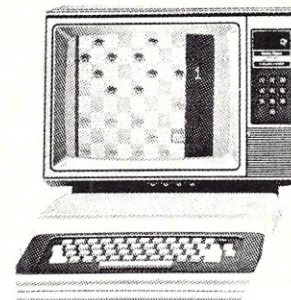
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# Computerized Table Tennis, Anyone?

By Willis H. Cook

**E**veryone knows that a full-fledged computer can do a lot more than a video game device can, but can it do as much?

This program duplicates one of the original (if not *the* original) games introduced by the Atari Company several years ago. Judge for yourself how well this BASIC version performs. If nothing else, you will probably agree

that imitating a fast-paced video game on a general-purpose computer is not a trivial task.

## Program Features

The first requirement of the program was that rebounds had to be realistic. If the ball strikes a surface at, say, 20 degrees, it should rebound at 20 degrees. The program does this

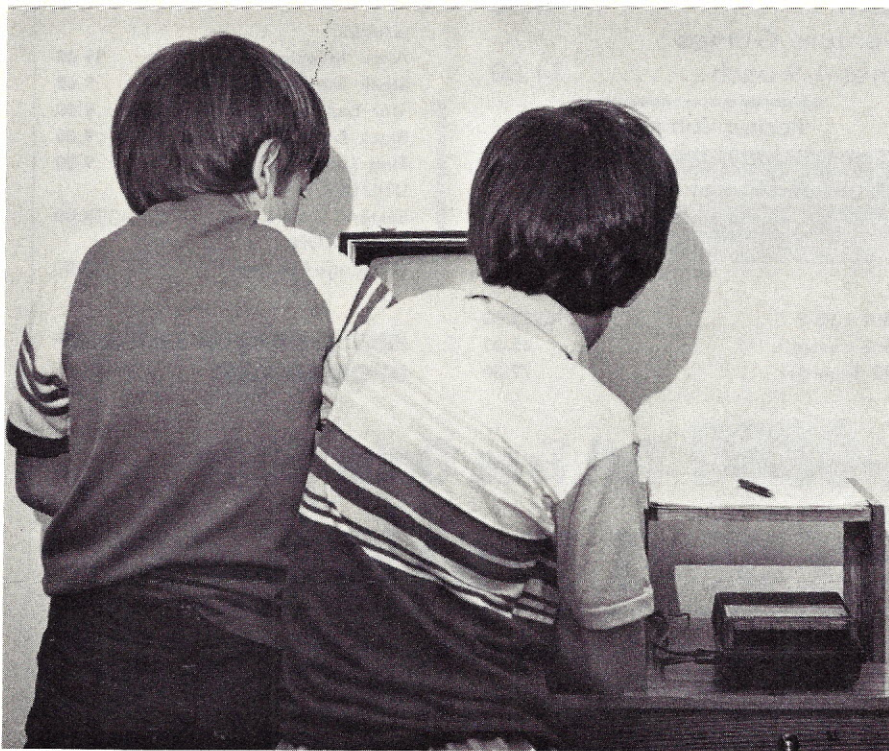
but it takes a lot of code; I'll discuss the procedure later.

The program will work for either one or two players. With two playing, your opponent scores a point whenever the ball reaches the border at your end of the screen. The scores are displayed just above the top of the border. The winner is the first one to reach a score of 15. My computer doesn't have joysticks, so I use designated keys on the keyboard to move the paddles up and down. Key 1 raises and key 2 lowers the left paddle, and keys M and N control the right paddle. Two two-handed players create a lot of activity on one keyboard, but the crowding adds to the fun.

When one person is playing, he uses the left-hand paddle. When the ball hits the border on the right it simply rebounds, as if against a backboard. The game ends after he has missed 15 balls. The computer then rates his play on a scale of 1 to 10.

The program also has a fast/slow feature. Implemented by means of a FOR...NEXT loop in line 450, the slow speed is slow enough for adults. Kids will naturally prefer the faster speed.

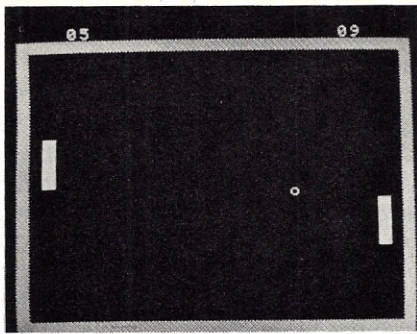
Serves are random, and originate from two different locations on the screen. Initially the ball was put into play from the center of the screen, but this meant that the player who



*A typical game of computer pingpong. Contrary to what you might expect, there is a lot of body contact involved with this program.*

*Address correspondence to Willis H. Cook, 1298 Renee Drive, Lilburn, GA 30247.*





A close-up of the screen display. Each paddle is individually movable. A game continues until one player reaches a score of 15.

took the serve did not have time to position his paddle correctly (unless he successfully guessed where the ball was heading). This condition seemed severe; with the current version of the program, if you have your paddle in the center of your court you can return any serve—if you're fast.

### Details of Operation

The *OSI Graphics Manual* illustrates 12 directions of motion that can be implemented by means of FOR...NEXT loops using various step values (refer to Fig. 1). For simplicity, I used only four of the 12 possible directions, represented by step values  $\pm 62$  and  $\pm 66$ . If the ball is traveling along the  $+66$  line and strikes a paddle, it should rebound along the  $+62$  line. If, however, it strikes the bottom border, it should rebound on the  $-62$  line. So, in order to determine the rebound, the program must know whether the ball has hit a horizontal or vertical surface. For rebounds from vertical planes, the sign of the step value remains unchanged.

There is also the special case (line 400) where the ball hits a corner: only the sign of the step value changes, not its magnitude. Lines 330 through 440 in the program determine rebounds. Line 290 checks the four adjacent locations surrounding the ball after

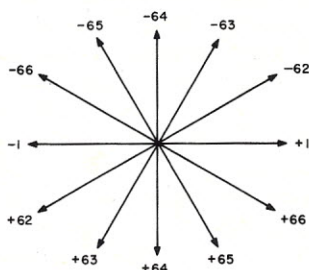


Fig. 1. Twelve directions of motion can be represented by changing the video display address by different increments.

### Listing 1. Computer pingpong program in OSI BASIC.

```

10 REM *****
20 REM *
30 REM * PING PONG *
40 REM *
50 REM *****
60 REM
70 A=111:H=56900:F=57089:P=187:POKE F,0
80 G=161:M=54210:K=57088:Q=54236:POKE 530,1
90 U=0:V=0:U1=53508:V1=53529
100 FOR I=1 TO 28:PRINT:NEXT:POKE H,2
110 GOSUB 670: REM INSTRUCTIONS
120 GOSUB 470: REM SET UP BORDER
130 GOSUB 500: REM SET UP PADDLES
140 REM INITIAL TRAJECTORY
150 D=INT(4*RND(1)+1):ON D GOTO 160,170,180,190
160 B= 62:L=53711:GOTO 200
170 B=-62:L=54927:GOTO 200
180 B= 66:L=53711:GOTO 200
190 B=-66:L=54927
200 POKE L,A
210 REM CHECK KEYBOARD FOR KEY CLOSURE
220 POKE K,128
230 IF PEEK(K)=128 THEN GOSUB 560
240 IF PEEK(K)= 64 THEN GOSUB 590
250 POKE K,4
260 IF PEEK(K)= 8 THEN GOSUB 620
270 IF PEEK(K)= 4 THEN GOSUB 650
280 W=PEEK(L+1):X=PEEK(L-1):Y=PEEK(L+64):Z=PEEK(L-64)
290 IF W=32 AND X=32 AND Y=32 AND Z=32 THEN 450
300 REM 'BLIP' SOUND
310 POKE F,50:FOR I=1 TO 10:NEXT I:POKE F,0
320 REM CALCULATE REBOUND
330 C=ABS(B)
340 N=2*(C-64):C=C-N
350 IF X=P THEN 850
360 IF E=1 AND W=P THEN 410
370 IF W=P THEN 800
380 IF W=G OR X=G THEN J=J+1:GOTO 410
390 IF B<0 THEN B=C:GOTO 450
400 B=-C:GOTO 450
410 IF Y=P OR Z=P THEN B=-B:GOTO 450
420 IF B<0 THEN B=-C:GOTO 450
430 B=C:GOTO 450
440 REM R DETERMINES THE SPEED.
450 FOR I=1 TO R:NEXT I
460 POKE L,32:POKE L+B,A:L=L+B:GOTO 220
470 FOR I=53568 TO 53598:POKE I,P:NEXT
480 FOR I=53632 TO 55050 STEP 64:POKE I,P:POKE I+30,P:NEXT
490 FOR I=55040 TO 55070:POKE I,P:NEXT:POKE 55104,32:RETURN
500 IF E=1 THEN 540
510 REM RIGHT PADDLE
520 FOR I=54172 TO 54364 STEP 64:POKE I,G:NEXT
530 REM LEFT PADDLE
540 FOR I=54146 TO 54338 STEP 64:POKE I,G:NEXT:RETURN
550 REM LEFT PADDLE UP
560 IF M=53698 THEN RETURN
570 M=M-64:POKE M-64,G:POKE M+192,32:RETURN
580 REM LEFT PADDLE DOWN
590 IF M=54850 THEN RETURN
600 M=M+64:POKE M+128,G:POKE M-128,32:RETURN
610 REM RIGHT PADDLE UP
620 IF Q=53724 THEN RETURN
630 Q=Q-64:POKE Q-64,G:POKE Q+192,32:RETURN
640 REM RIGHT PADDLE DOWN
650 IF Q=54876 THEN RETURN
660 Q=Q+64:POKE Q+128,G:POKE Q-128,32:RETURN
670 PRINT TAB(8)"WELCOME TO":PRINT:PRINT
680 PRINT TAB(5)"P I N G P O N G":PRINT:PRINT
690 PRINT:INPUT"HOW MANY PLAYERS ARE THERE";E
700 C$="":IF E=2 THEN C$=" LEFT"
710 PRINT:PRINT"1 MOVES THE";C$;" PADDLE UP."
720 PRINT"2 MOVES IT DOWN.":PRINT:IF E=1 THEN 750
730 PRINT:PRINT"N MOVES THE RIGHT PADDLE UP."
740 PRINT"M MOVES IT DOWN.":PRINT
750 R=20:PRINT"DO YOU WANT A FAST"
760 INPUT"OR A SLOW GAME";C$
770 IF LEFT$(C$,1)="F" THEN R=0
780 FOR I=1 TO 1500:NEXT I
790 FOR I=1 TO 28:PRINT:NEXT:RETURN
800 U=U+1:POKE U1,INT(U/10)+48
810 IF U<10 THEN POKE U1+1,U+48:GOTO 830

```

More



*Listing 1 continued.*

```

820 POKE U1+1,U+38
830 POKE L,32:IF U=15 THEN 940
840 GOTO 890
850 V=V+1:POKE V1,INT(V/10)+48
860 IF V<10 THEN POKE V1+1,V+48:GOTO 880
870 POKE V1+1,V+38
880 POKE L,32:IF V=15 THEN 940
890 FOR I=1 TO 50:POKE K,128:IF PEEK(K)=128 THEN GOSUB 560
900 IF PEEK(K)=64 THEN GOSUB 590
910 POKE K,4:IF PEEK(K)=8 THEN GOSUB 620
920 IF PEEK(K)=4 THEN GOSUB 650
930 NEXT I:GOTO 150
940 IF E=1 THEN 960
950 IF U>V THEN T1=54020:GOTO 970
960 T1=54035
970 IF E<2 THEN 1010
980 FOR I=1 TO 7:READ T:POKE T1+I,T:NEXT
990 FOR I=1 TO 2000:NEXT I:POKE 530,0
1000 FOR I=1 TO 28:PRINT:NEXT:POKE H,1:END
1010 FOR I=1 TO 7:READ T:NEXT:FOR I=8 TO 18:READ T
1020 POKE T1+I-8,T:NEXT:J=INT(J/15)
1030 FOR I=1 TO 2000:NEXT I:FOR I=1 TO 28:PRINT:NEXT
1040 PRINT"ON A SCALE OF 1 TO 10"
1050 PRINT"YOU RATE A";J:GOTO 990
1060 DATA 87,73,78,78,69,82,33,69,78
1070 DATA 68,32,79,70,32,71,65,77,69

```

CHANGE LINE 80 TO

```
80 G=161:M=54210:K=57088:Q=54236:POKE 2073,96
```

CHANGE LINE 990 TO

```
990 FOR I=1 TO 2000:NEXT I:POKE 2073,173
```

*Listing 2. Line changes for disk systems using OS-65D, V 3.2.*

A	ASCII code for a lowercase "O." Used for the ball.
H	Output display format, 32×32 or 32×64.
F	Sound port.
P	Video display character code for a gray display cell. Used for border.
G	Video display code for a solid white display cell. Used for paddles.
M	Initial position of left paddle.
K	Keyboard port.
Q	Initial position of right paddle.
U	Left-side player's score.
V	Right-side player's score.
U1	POKE location for left player's score.
V1	POKE location for right player's score.
I	Miscellaneous counter.
D	Random integer between 1 and 4. Determines initial ball location and trajectory.
B	Display address increment. Determines the ball trajectory.
L	Instantaneous ball location.
W	Location just to the right of the ball, i.e., L+1.
X	Location just to the left of the ball, i.e., L-1.
Y	Location just below the ball, i.e., L+64.
Z	Location just above the ball, i.e., L-64.
C,N	Temporary variables used in calculating B after a rebound.
R	Speed controller.
E	Number of players.
T1	POKE location for end-of-game message.
T	ASCII code data for end-of-game message.

*Table of variables.*

each move to see if the ball has hit anything. If it has, control passes to the rebound section.

If the procedure sounds complicated, bear in mind that during the actual programming I used about two percent analytical reasoning and 98 percent trial and error. While trying to perfect the rebound algorithm, I was working with only those parts of the program that set up the border with the bouncing ball inside. Every now and then the ball would break through the border and bounce around between the border and the edge of the screen. And sometimes it bounced completely off the screen and into the program somewhere. (Instead of poking to a video display address, I was poking to the RAM where the program was stored.)

Also notice lines 510-660, which control the paddles' movements. You have to stop moving the paddle when it gets to the top or bottom of the screen or you might push it right into the program.

Line 310 causes a "blip" sound whenever the ball hits the border or a paddle. This uses the computer's programmable audio output with an external audio amplifier. Early models of the C2-4P do not have sound output, but the program can be run unchanged on these machines.

Lines 470-490 create the border. If you decide to change the size of the border, be sure to change the dimensions in multiples of two or you will experience the breakthrough problem mentioned earlier.

Lines 220-270 scan the keyboard repeatedly to see if either player wants to move his paddle. Between turns, also, the players must be able to move the paddles to anticipate the next serve. So, rather than waste the interval in a do-nothing loop, lines 890-930 scan the keyboard again.

When using the keyboard-scan feature, the control-C (interrupt) function must be disabled. Line 80 disables control-C, and line 990 restores the function when the program ends. This is done differently on BASIC-in-ROM and disk systems. Listing 1 is for ROM-based machines. If you use disk BASIC with the OS-65D version 3.2 operating system, change the lines as shown in Listing 2. If you use a different disk operating system, check your manual for the proper control-C enable/disable techniques.

## Evaluation

After running this program you



will probably agree that it has two shortcomings compared to the original. One is execution speed. Although the combination of 6502 CPU and Microsoft BASIC is one of the fastest around, things slow down a bit when two players must maneuver their paddles simultaneously.

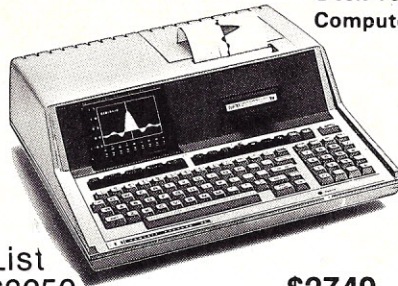
The program must scan the keyboard, move the paddles and the ball, and then check at least six display memory addresses before moving the ball again. I don't think it is an objectionable problem but it certainly is noticeable. A possible solution, short of rewriting the entire program in assembly language, would be to translate the paddle-move routines into assembly language and access them with the USR function.

The other problem is a lack of resolution in the 32x32 display format. Because the ball always travels on a low-angle trajectory, it moves two display cells horizontally for each cell it moves vertically. Each cell is relatively large, so the apparent motion is rather jumpy. I originally wrote the program for the 32x64 format and the resolution was better, but there were a couple of other drawbacks. I never could get the border centered on the screen, and the pingpong ball trajectory tended to repeat itself with predictable uniformity. Thus, the 32x32 format was a compromise.

Nevertheless, the end result is reasonably successful. Hopefully, some of the techniques used in this program will turn up again in other applications. And the exercise has at least given me a healthy respect for video display programming. ■

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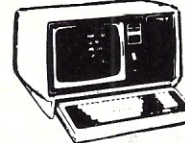
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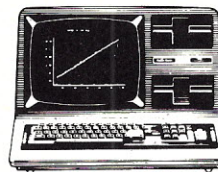
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# OSI Clear-Screen Command

By Cyril Bradshaw

```
RUN"CHANGE","PASS"

DISK CHANGE UTILITY

MODE: HEX(H), DEC(D) ? H
UNIT ? A
ADDRESS OFFSET ? C00
ADDRESS ? 2DCE
00002DCE 00 ? A2
00002DCF 00 ? D8
00002DD0 00 ? A9
00002DD1 00 ? D0
00002DD2 00 ? 85
00002DD3 00 ? FF
00002DD4 00 ? A9
00002DD5 00 ? 00
00002DD6 00 ? 85
00002DD7 00 ? FE
00002DD8 00 ? A8
00002DD9 00 ? A9
00002DDA 00 ? 20
00002DDB 00 ? 91
00002DDC 00 ? FE
00002DDD 00 ? C8
00002DDE 00 ? D0
00002DDF 00 ? FB
00002DE0 00 ? E6
00002DE1 00 ? FF
00002DE2 00 ? E4
00002DE3 00 ? FF
00002DE4 00 ? D0
00002DE5 00 ? F5
00002DE6 00 ? 60
00002DE7 00 ? .
ADDRESS ? 220E
0000220E A5 ? CD
0000220F 09 ? 2D
00002210 A5 ? .
ADDRESS ? 231A
0000231A L 4C ? 43
0000231B E 45 ? 4C
0000231C D4 ? D3
0000231D G 47 ? X
```

Listing 1. OSI disk modification.

**M**y C2 8P had everything, except a decent screen-clear command. The FOR: NEXT loop took forever to execute. (Actually, it takes one second, but it seems like forever.) It scrolled the copy off the screen and wasted time that I could have been using to enter new data, and caused me much mental anguish. Lesser breeds of computers could blank the screen with a simple command—it was downright embarrassing.

(I understand why Ohio Scientific didn't include the CLS command in OS-65U. The C3 with a serial terminal doesn't need it, since the terminal has, self-contained, all the operating language it needs. This is just for the C3's poor relatives.)

A peek into the OS-65U language (system) showed some unoccupied space on the disk where a machine-language routine could be tucked away. But how would I command the routine? What could I use for a command word, and where could it be stored? A solution to this was to find the least-used reserved word and substitute my choice for it.

That was easy. The least-used reserved word—actually, I never use it—is LET. Its use is optional, even superfluous, since LET A=B and A=B are equivalent statements. Why not replace the reserved word LET with CLS, a commonly used command for clearing the screen?

## Modification

Some of the empty language (system) areas on the disk are not suitable. They won't accept the routine

and permit it to function properly due to program interferences or other problems peculiar to the language. By trial and error, I found that \$2DCD and on was a good residency for the program. The easiest way to enter the routine is through the OS-65U Disk Change Utility program.

To enter the routine and modification to your disk, call in the Change program by entering RUN "CHANGE","PASS." Use hexadecimal addresses; i.e., enter H in response to MODE: HEX(H), DEC(D) ?. Then select the disk drive containing the disk whose language you are about to change; i.e., UNIT ? A (or B as the case may be). In response to ADDRESS OFFSET ? enter C00, and to the inquiry ADDRESS ? respond with 2DCE.

Follow the procedure in Listing 1. Carefully enter the values in the column to the right of the ? as each address appears (being certain of the sequence) and enter a period (.) at the indicated address and the new address as called for. An X exits from the program, followed by CLOSE. This will enter CLS for LET and redirect it to the routine you have just entered.

Reboot the system into the machine, and CLS will then give the results you desired.

Your language now contains CLS, and if any of your programs had LET in them, it will now be CLS A=B, or

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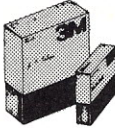
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some permutation of this. Just find the CLS commands (the old LET commands), or let your computer find them for you, so that they can be changed. To have your computer find them, run your program, and when you come to that former LET command, the screen will clear and give you a ?SN ERROR and the offending line number.

Now you need to list your programs, find the offensive FOR C=1 TO 30:PRINT:NEXT loops in them and replace them with CLS. Now your screen will clear in .022 second, instead of one second with the old FOR:NEXT loop scrolling screen clear time. ■



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# A Tale of Two Screen Dumps

By Jim Hansen

One of the remarkable features of the Apple computer is its high-resolution graphics. Indeed, there are many accessory devices on the market today that exploit this capability. These range from television interfaces for digitizing and displaying a television image on the Apple screen to digitizing pallets that can be used to make digital copies of maps, plans, pictures and the like. Graphics im-

ages can also be generated under program control within the Apple itself.

Images can be put into the display memory and stored on disk. But sometimes you'll want a hard copy. You can get it by either taking a photograph of the screen or dumping to a printer with graphics capability. Strangely, Apple has ignored the problem of getting hard copies, and Apple users are left to resolve the sit-

uation on their own.

Vendors of screen dump programs seem to support the Integral Data Systems 440G Paper Tiger Printer the best. Computer Stations, Inc. (12 Crossroads Plaza, Granite City, IL 62040), sells two such programs. Both are available at many computer stores or from Computer Stations.

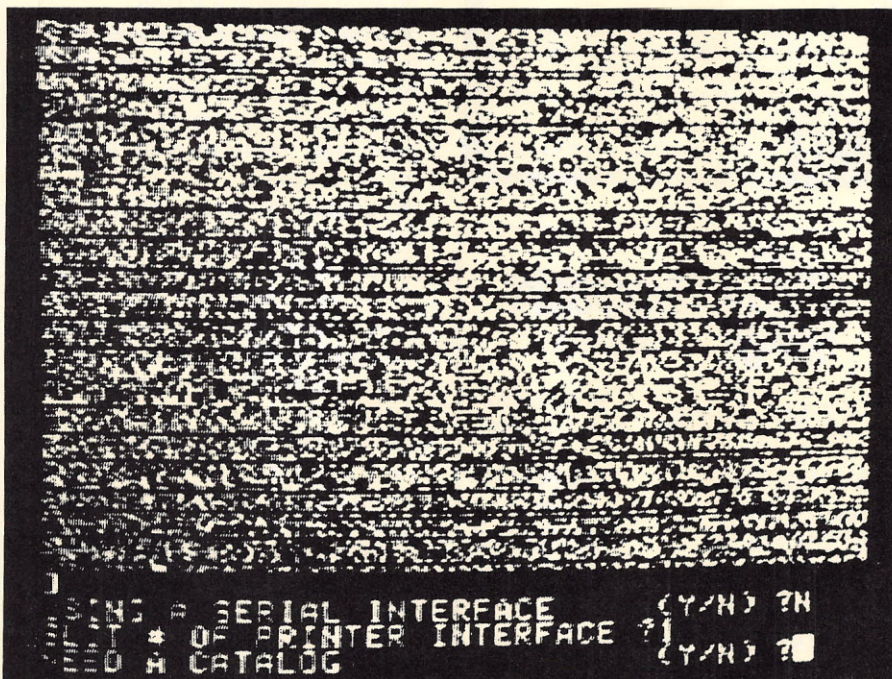
The programs run on either the Apple II or Apple II Plus. The original, Paper Tiger Graphics Software, has been available since 1979. Enhanced Paper Tiger Software was released last year.

To use either package, your Apple must have at least one disk drive. No specific memory requirements are spelled out in the manuals supplied by Computer Stations.

## Two Complete Programs

Both packages are complete programs in themselves. When placed in the master disk drive and booted, they ask for information regarding the type and location (slot number) of your printer interface. The enhanced version lets you use six different popular interface cards. The original package works only with the Apple Centronics parallel card or the Apple high-speed serial interface.

The older version operates in the "20 question" mode; that is, it solicits information by a series of questions answered yes or no. It can operate only on the first high-resolution page of the Apple and can print either a



Operation of Paper Tiger graphics (the original Computer Stations screen dump program). Two versions of the screen dump are provided on the disk of the original screen dump. One was written to run with Applesoft, the other was for integer BASIC. Operation for both versions is the same. When run, high-resolution screen number one is displayed, and a series of questions answered with "Y/N" are presented. Loading the program wipes the high-resolution screen, leaving the image shown above.

Jim Hansen, Methodist Hill, Lebanon, NH 03766.



positive or negative image of the graphics display. This is necessary since it is unlikely that you will want a graph printed black with white dots; photographic pictures, on the other hand, must be printed this way or you will get a negative image. The program can also double the size of the printed image. Generally, it will prompt you for a file name, ask how you want the picture printed, print it and recycle.

The enhanced package presents two menus. The options available from the first menu at the beginning of the program run select the type of interface and set slot number. The second menu then appears and remains until you are finished. It lets you dump either high-resolution screen; choose regular or double size printout; position the picture on the left, right or center of the printed page; choose reversed or normal image (plot/picture mode); display the selected high-resolution memory on the screen; or display the disk catalog.

Option selection is simple. Each item on the menu is numbered. The selected mode for each item is displayed on the screen using reverse print. To switch to another mode you type the number of the item. The selection automatically moves to the next available option after each menu item. It is a simple and convenient way to select any combination of about a dozen options or commands.

The enhanced package offers several benefits over that of the less expensive, older version. It lets you use more (and in some cases less expensive) interfaces. It can dump either high-resolution page instead of only the first one, and it can position the picture on the printed sheet. Finally, it is easier and more convenient to use, since it uses a menu and removes most of the vestiges of Teletype data entry methods.

Both programs work without error. Interestingly, the folks at Computer Stations found that by setting the Paper Tiger to the 50 Hz power selection and using the double-sized printout, the horizontal and vertical dot resolution becomes more closely matched (they claim .7 percent). Thus, a circle on the Apple screen will print out as a circle instead of the usual goose egg. This will only work if you set the 440 to 50 Hz and run it at 60 Hz, and thus will probably apply only to North American countries. Those in Europe and elsewhere

served with 50 Hz power will not be able to use this "feature." (I have not tried this out and so can't verify its operation.)

### Personal Comments

I have used the older version for some time now and have no complaints. Generally, images must be saved to disk before they can be printed, since loading a program from DOS wipes out the high-resolution screen. If you have not seen the enhanced version run, chances are you will be satisfied.

The biggest improvement in the enhanced version is that you can choose from a wider variety of interface cards. The older version, as mentioned before, lets you use only two of Apple's cards. The only other feature that influences the actual opera-

tion is that the picture can be printed on the left, center or right side of the page. This is nice to have, but I got the same results by moving the paper tractors.

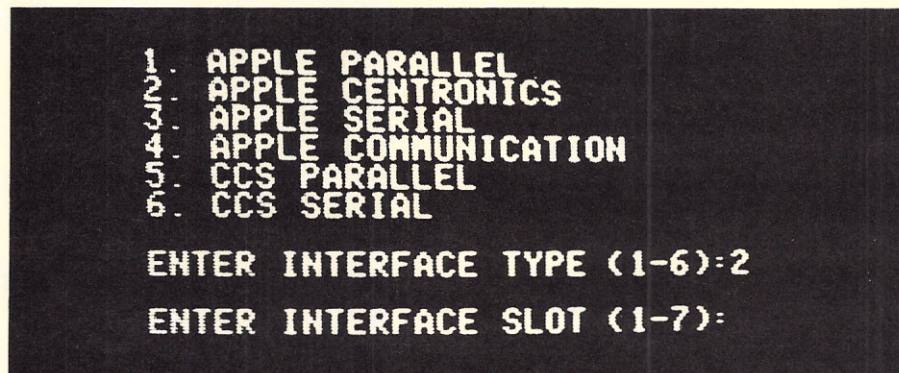
Another impressive and convenient feature is the menu-driven option selection. I was impressed with the various human engineering features of this software package. Simple concise directions—either of the menus or the catalog—are presented as required with every display; all operations are easily controlled; and the information is not ambiguous, extraneous or misleading.

### What You Get for Your Money

The enhanced version, which comes on a disk, includes several demonstration pictures and the instruction manual, as brief as the old



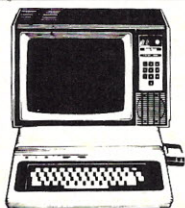
*If a catalog is requested, a program from it may be loaded after the prompt for "Picture Name." The program then asks whether the image is to be inverted (printed positive or negative) and whether a double size (EXPAND SCREEN) print is to be made. Printout takes place after the expand screen question is answered.*



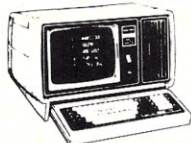
*Operation of the Enhanced Paper Tiger Graphics Software. When run, a menu listing the available interface drivers is displayed and the user is asked to type in the number corresponding to the type of interface in use. Next, the slot number of the interface is requested.*



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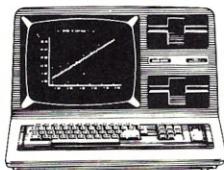
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APPLE CENTRONICS INTERFACE IN SLOT 1

ENHANCED TIGER GRAPHICS  
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PRESS <CTRL-C> TO QUIT  
PRESS <ESC> TO RESTART  
PRESS <1-7> TO CHANGE OR EXECUTE

1. PAGE: 1/2  
2. SIZE: NORMAL/EXPANDED  
3. IMAGE: PLOT/PICTURE  
4. JUSTIFICATION: LEFT/CENTER/RIGHT  
5. CATALOG  
6. DISPLAY GRAPHICS  
7. PRINT GRAPHICS

ENTER OPTION -->

After the slot number is entered, a second menu is displayed. Any of the options may be changed or commands issued by simply typing the number of the menu item. Notice that complete operator instructions are displayed along with the menu. If a catalog is requested, the menu disappears and is replaced with the catalog. The desired program from the catalog is selected by positioning the cursor next to the file name using the space bar, then typing a return. The file is then loaded into screen memory and the catalog is replaced by the menu. If command 6 (DISPLAY GRAPHICS) were issued by typing a 6, the high-resolution page selected by item 1 (PAGE) will be displayed until any key is typed, at which time the menu is restored. The image is printed when command 7 is typed.

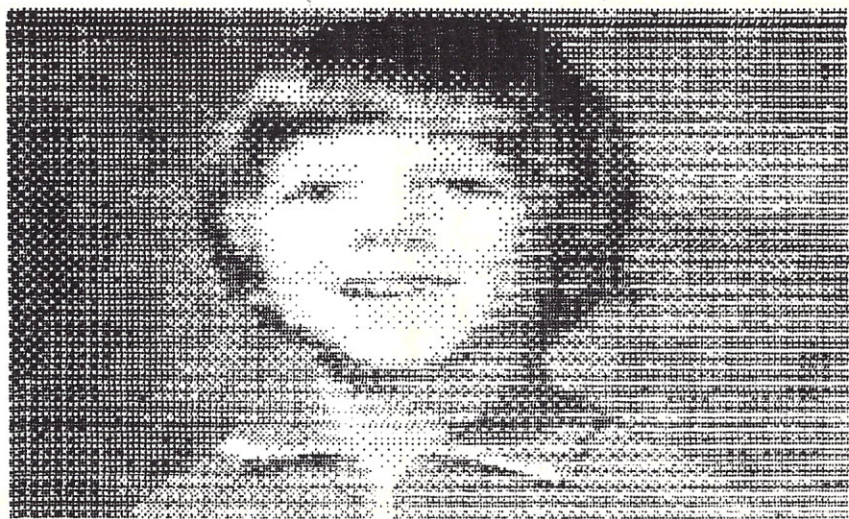
manual, but also describes how to save a picture to disk and gives connector wiring information for several interfaces.

The old software package includes two versions of the screen dump program. One is for use with Applesoft, the other with integer BASIC. The manual, though adequate, is not as elaborate or detailed as that sold with the enhanced screen dump.

## Conclusions

Is either worth the price? If you want a commercial screen dump pro-

gram for the Apple that works, and works well, either one will do. The original price for the old screen dump was \$24.95; it is now valued at \$34.95. The enhanced version is \$44.95. The Scotch in me says that these prices are a bit steep for what would involve a couple of weeks' work after supper if you were to write the same programs from scratch. But you get what you pay for; in this case, fully debugged programs, each of which does what it is advertised to do with a frustration factor of approximately zero. ■



Printed picture done on an IDS 440G printer.



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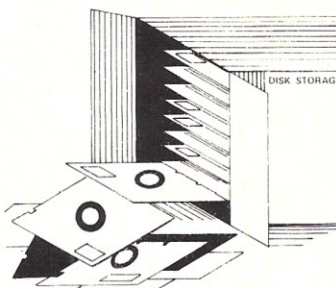
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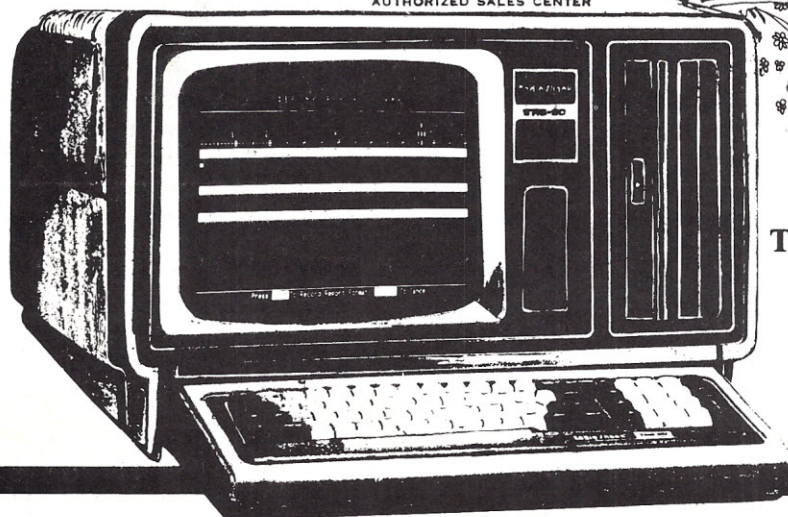
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# Word Wizardry

By Charles H. Strom

**T**he Exidy Sorcerer computer is a single-board machine based on the Z-80 microprocessing chip. It is similar to the TRS-80 or Apple in appearance; it comes as a single unit with an integral keyboard, and the user must supply a video monitor and tape recorders.

The Sorcerer is equipped with a dual cassette interface capable of transferring data at 300 or 1200 bps (bits per second). It also has a serial RS-232 interface, actually identical to the cassette port, and a parallel, Centronics-compatible, interface.

As an inveterate hardware hacker, I of course looked for ways to expand the system. I had considerable experience with disk-based machines and the CP/M disk operating system, the de facto industry standard. I don't need to tell anyone the advantages of a disk system.

Exidy was wise in designing S-100 compatibility into the Sorcerer. It was my reason for buying the unit. The expansion box contains a power supply that supports the six card-edge connectors and all circuitry necessary to allow translation between the Sorcerer bus and the proposed IEEE-defined S-100 bus. Refer to the excellent Exidy technical manuals for a description of the bus differences. Exidy does supply two disk systems that plug in directly to the expansion interface edge connector on the Sorcerer, but I opted for eight-inch disks for several reasons; I wanted the S-100 flexibility, and the cost of an eight-inch system configured by myself from several sources was no more expensive than buying a

ready-to-run five-inch system from Exidy.

My hardware consists of a Micromation disk controller and a single Shugart 801 drive, power supply and enclosure from Morrow/Thinker Toys. The controller has an on-board PROM specifically designed for the Sorcerer. It resides at the ROM-Pac address space; thus, when the system is powered up, the disk automatically boots up the operating system.

The controller allows a mix of single- or double-density drives, and the density is automatically determined when a disk is booted. Micromation is a company to respect—both their hardware and software are exceptional.

The CP/M disk operating system has a hardware-dependent portion called BIOS (basic input-output system), which is the only part that is changed when adapting CP/M to different hardware configurations. Some vendors supply a skeleton BIOS that allows little flexibility without reprogramming, but Micromation supplies a fully-commented, well-implemented source listing. Morrow, from whom I obtained the drive itself, is one of the oldest and most respected names in hardware design for micros, with low prices. What more can you ask? I also bought two 8K Econoram-II static memory boards from Godbout (Computhink), another pioneer in excellent design of hardware. The Sorcerer uses dynamic memory in the machine itself, but to eliminate any possible problems with memory in the expansion box, I selected a static design.

To run my word processing package, I have a DTC-300 daisy-wheel terminal interfaced to the serial port supplied on the Micromation disk controller. This is a fully-implemented serial port with baud rate selection and handshaking. The Micromation BIOS uses this serial port to run the CP/M list device, so those of you who are neophytes at assembly-level programming need not fear.

I might mention that CP/M, although very versatile, is not simple to use for a beginner. The documentation leaves something to be desired, and reminds me of IBM manuals. Modification is even more difficult and is not recommended for a newcomer to assembly language. Once you gain some experience with it, however, it shows itself to be a fine product.

As I previously noted, CP/M has become a sort of standard; the vast majority of disk-based software available for 8080- or Z-80-based machines running with an S-100 bus is designed to run under CP/M. Other operating systems—none of which I have used—may be excellent products, but they are of questionable use to a user who wants to run a variety of software designed by a third party.

## Wordstar

Wordstar, a product of Micropro, was designed to run under CP/M. The version I use is 93A, which re-

---

*Address correspondence to Charles H. Strom, 100 Bleecker St., #4C, New York, NY 10012.*



quires 44K of memory. The explanation for this rather large memory requirement will become clear as I describe the wealth of features available under Wordstar. However, before you can edit a document, the program must be installed, or patched, for the specific hardware configuration. Micropro supplies a program, called Install, which automatically does just that for the most common terminals and printers, but the Sorcerer computer and the DTC-300 printer are not included.

Basically, I must configure the program for the Sorcerer as a memory-mapped video device. A series of patches are required for screen width, number of lines, starting address of the video RAM space and so on. This is straightforward and clearly documented. Wordstar employs reverse video for menu display, marking sections of text prior to moves, etc., and this creates a problem.

The Sorcerer does not have a reverse video (black-on-white) character set. The solution is to insert a jump at the Wordstar terminal initialization location (TERMINI) and to write a simple machine-language routine to generate the inverse video characters. This is simpler than it sounds; the standard ASCII character set is defined starting at location F800 hex. Each location is complemented and the result is stored in the user-defined graphics space (starting at FC00 hex) such that by setting the high-order bit of the character, the inverse character is addressed.

This procedure need only be performed when initially loading the program, since the clear screen command, which resets the Sorcerer's graphics, is not generated when Wordstar is used in the memory-mapped video mode. According to Micropro, Wordstar also requires cursor move routines, but I see no difference with or without them.

Wordstar is designed for installation of the more popular printers, such as any Teletype-like device, a selectric-like printer or the various daisy-wheel printers. The latter allow more complicated functions such as microspace justification and super and subscripting, but boldface and underlining can be supported with dumb printers as well. My printer is an oldie, and in fact uses the Intel 4004, the first microcomputer chip, as a controller. It was a simple matter to patch some of the daisy-wheel fea-

tures, but I have no way of locating the area in Wordstar responsible for microspace justification. I just ordered the customization notes, and at \$100, they had better supply the needed information!

Before going on with a general description of Wordstar, I need to discuss a few problems associated with this hardware-software mix. The designers at Exidy appear to have a philosophy that encourages the use of firmware (software burned into a read-only memory device) rather than hardware. The serial port does not have its own UART, and more importantly, the keyboard is not hardware-encoded. This means that every time a key is pressed, the CPU must scan the keyboard and then generate the proper character. This is a short-sighted design, for the lack of a two-dollar encoder chip makes the keyboard excessively slow. Wordstar polls the keyboard a certain number of times as a timing loop when menus are displayed, the cursor is blinked, etc.; as a result, there is a long wait when this loop is executed. I have been unable to get a fix from Micropro.

A more serious problem becomes apparent when the user reaches the end of a text line. The program has default settings of word-wrap, which means if a word is longer than the margins allow, it will automatically be moved to the next line, and right justification, which means spaces are inserted in the line so that the right margin is even throughout the document. (When printing, if microspace justification is implemented, the spacing is distributed evenly for a better-looking document.)

The Sorcerer keyboard has no roll-over; in other words, when the previous line of text is being automatically rearranged, characters are lost if the typist is inputting keystrokes at even a rather low rate. This is not the fault of Wordstar, which, when used with a normal keyboard, operates without losing any characters. I've found two fixes.

The word wrap and justification features may be toggled off, and text may be entered as a continuous string. It is a simple matter to turn these features on again at the end of the session and reform the document with the ↑B command. (↑ means pressing the control key simultaneously with the other key.) The other solution is to implement the DTC-300 daisy-wheel terminal keyboard as the

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console input device. This keyboard has a standard hardware encoder, and Wordstar thus operates without any of the aforementioned problems.

### Other Features

A menu, displayed at all times, reminds the user of the most-used commands such as cursor move, character, word and line deletes, etc. Also, several secondary menus can be called up to explain other commands, and, in the case of two-letter commands, automatically are called when the user pauses before entering the second command letter. It is obvious that a great deal of thinking went into the design. The menus can be suppressed if you want to use the entire screen.

The manual, incidentally, is very complete and was written with the Wordstar program. It is an excellent example of what Wordstar is able to do, and also shows Micropro's faith in their product. There is a complete index of commands as well.

Commands such as "find" or "replace a character string" are practically self-explanatory, but the

manual comes in handy to detail the various options built into these commands. Once again, the explanations can be called up on the screen. Incidentally, the messages occupy a separate file called WSMGS, which is a respectable 19K size. Another valuable feature allows the input of another disk file at any desired place with a single command. Thus, boiler plate, or preformed, text can be inserted in another document.

Rather than go on about the many dozens of additional features, I recommend that you buy the manual. This should be a standard procedure when you plan to spend almost \$500 for a software product.

One feature curiously absent from Wordstar is a simple way of preparing a series of letters from a mailing list. Micropro suggests putting a special symbol such as \$ in place of an inside address, for example, and then calling in the real address from an external file and using a replace command to place the address at the specified location. This sounds like an inconvenient, though workable, solution. There is an enhanced Wordstar

now available that has more convenient mailing list features in it, but I don't feel like spending more than \$100 extra just for this feature. There are custom mail list programs available for just such a purpose.

### Conclusion

I'm quite pleased with Wordstar. I've been exposed to most of the dedicated word processing systems available in the commercial market, and although the use of dedicated keys rather than control keys makes them simpler to master, I don't really feel that they have much of an advantage as the user becomes more practiced; the alternative of a package such as Wordstar allows purchase of much more general-purpose hardware that can be adapted to tasks other than word processing. The Sorcerer has also proved of great utility; I only wish that Exidy had included more hardware in the keyboard. Well, if things turned out perfectly, I would be miserable. After all, what good is a microcomputer system if you can't spend enjoyable hours trying to wring out better performance from it? ■

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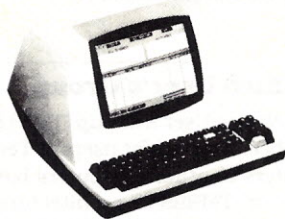
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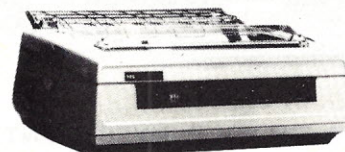
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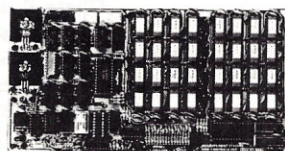


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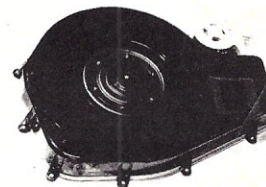
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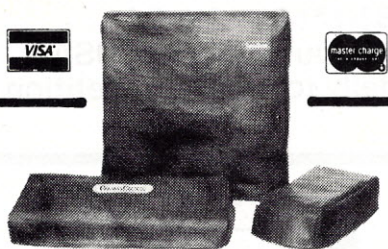
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## Computerfest '81

The Midwest Affiliation of Computer Clubs (MACC) is sponsoring Computerfest '81 at Franklin University, Columbus, OH, on May 29-31. Seminars and workshops, as well as exhibits, a flea market and contests, will be featured. For more information, send an SASE to Computerfest '81, c/o Paul Pittenger, 215 Delphi, Apt. J, Columbus, OH 43202.

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## Southeastern Michigan Computer Organization

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## Technico User's Group

A Technico User's Group (TUG) has recently been formed for users of Technico computers or other computers based on TI 990 or TMS9900 architecture. The group plans to publish a newsletter and is soliciting articles on software, hardware and applications, as well as ads for software and hardware for sale. Contact Penn S. Avera, Quantum Data Systems, Inc., 259 So. Farragut Ter., Philadelphia, PA 19139.

# COMPUTER CLINIC

We recently purchased a Mits Altair 8800-B Turnkey with 5-1/4 inch disks. The system came with BASIC, Release 5.0, and DOS manuals, but did not come with the DOS software. We need some help in obtaining information on the location and price of the DOS software. Also, we would be interested in any documentation on the various computer boards used by this system.

**Chris E. Lyons**  
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I have purchased a used SOL 8080 Processor Tech computer and a bare 16K-64K Dynamic RAM board. I have no schematics or parts listing for this board. Can anyone provide me with this information?

**Keith A. Mansfield**  
1272 Elmsmere Lane  
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Does anyone have the KIM text editor/KIM assembler manual and listing published by MOS Technology Sales in January 1977? I need a copy of the editor/assembler hex dump.

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# CALENDAR

## Trenton Computer Festival

The sixth annual Trenton Computer Festival will be held April 25-26 at Trenton State College. It will feature a flea market, commercial exhibits, speakers, user group sessions, free short courses, demonstrations and a computer graphics theater. Computer conference sessions and forums will be held on microcomputers in the home, education, medicine, amateur radio, music and the arts. Contact Dr. Allen Katz, Trenton State College, Hillwood Lakes, PO Box 940, Trenton, NJ 08625, 609-771-2487.

## Europe Software 1981

Europe Software 1981 will run from June 2-4 in Utrecht, The Netherlands. This international exhibition is billed as a promotion for the transfer of information about computer software products, software services, bureau services and education in information science. Inquiries should be addressed to Royal Netherlands Industries Fair, PO Box 8500, 3503 RM Utrecht, The Netherlands. Telephone: (30) 914 914, Telex: 47132.

## Computers and the Humanities

The University of Michigan will host the Fifth International Conference on Computers and the Humanities (ICCH/5) on May 17-20 and the Joint Conference on Easier and More Productive Use of Computing Systems on May 20-22. For further information, contact Ida M. Sanburn, 4258 Institute for Social Research, University of Michigan, Ann Arbor, MI 48106.

## Electro/81

The Electro Exhibition and Convention, a salute to advances in electronics products and ideas, will be held April 7-9 in New York City. Exhibits, including a special display of small computers for engineering and business applications, will be held at the New York Coliseum. The program schedule, to be held at the Sheraton Centre Hotel, will include technical sessions on microprocessor technology. Also to be featured are home and personal computers, instrumentation and peripheral concepts, analog interface and microcomputers. Contact Electro, 999 North Sepulveda Boulevard, El Segundo, CA 90245.

## National TRS-80 Microcomputer Show

The First Annual National TRS-80 Microcomputer Show will be held in New York City on May 22, 23 and 24 at the New York Statler Exposition Center (opposite Madison Square Garden and Pennsylvania Railroad Station). The show will feature commercial exhibits, seminars and speakers. For further information, contact Kengore Corporation, 3001 Route 27, Franklin Park, NJ 08823, 201-297-6918.

## Federal DP Expo

Federal DP Expo, the seventh annual conference and exposition for computer system users in the U. S. Government, will be held April 14-16 at the Sheraton Washington Hotel in Washington, DC. More than 150 computer-related companies will display and demonstrate hardware/software products, systems and services. Contact The Interface Group, 160 Speen St., Framingham, MA 01701, or call 800-225-4620; in Massachusetts call 617-879-4502.

## Computers in Education

The Third Annual Computers in Education Conference will be held at Seattle Pacific University, Seattle, WA, on May 1-2. It will feature panel discussions, talks, workshops and exhibits, with a special emphasis on the use of microcomputers in grades K-12. For further information, contact Jerry Johnson, Seattle Pacific University, Seattle, WA 98119.

## Southwest Computers Show

The Southwest Computer Show & Office Equipment Exposition will be held in Market Hall at the Dallas Market Center, April 9-12. The exposition is produced by National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167, 617-739-2000.

## Amateur Fair

The North Area Repeater Association will sponsor the state's largest swapfest and exposition for computer hobbyists and radio amateurs on May 30 at the Minnesota State Fairgrounds in St. Paul. Exhibits, booths and prizes will be featured. For information or reservations, write Amateur Fair, PO Box 30054, St. Paul, MN 55175.

## National Computer Conference

The National Computer Conference is scheduled for May 4-7, in McCormick Place, Chicago. Exhibits, program sessions and seminars, as well as special activities, are planned. For further information, contact AFIPS, PO Box 9658, 1815 N. Lynn St., Arlington, VA 22209, 703-558-3610.

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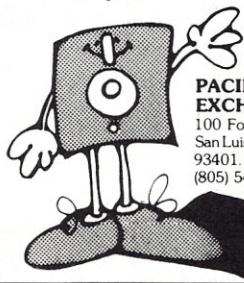
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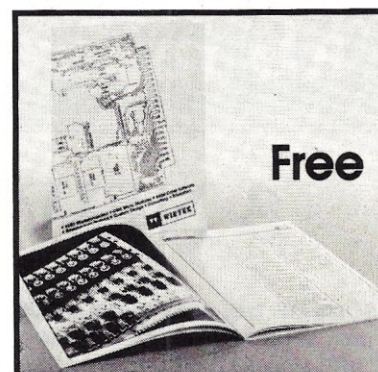
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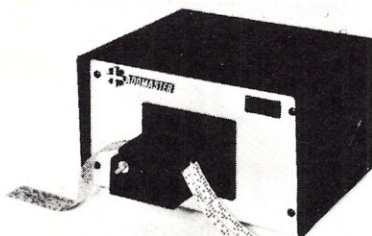
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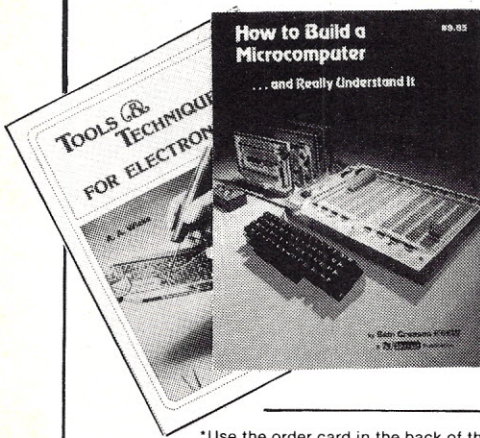
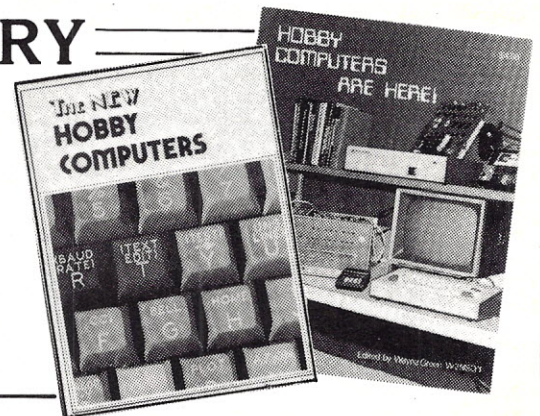
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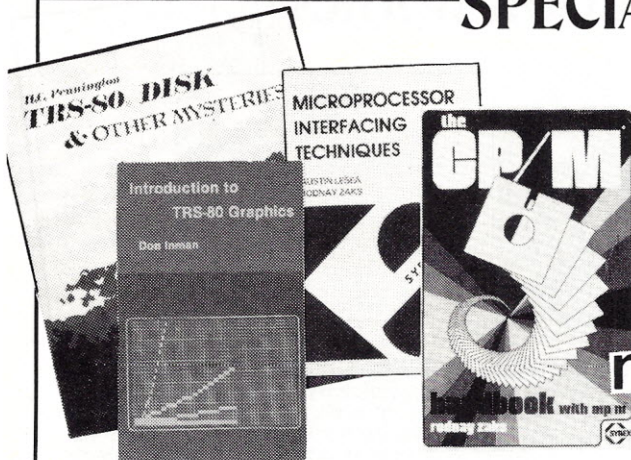
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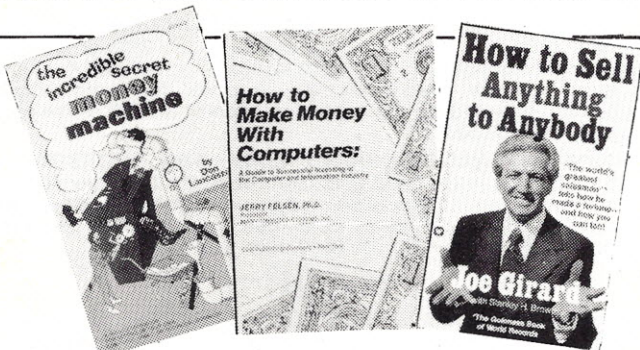
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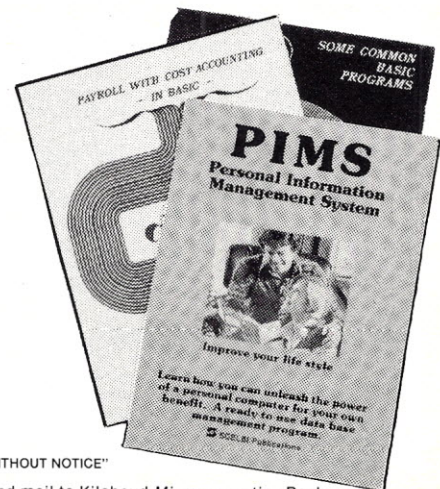
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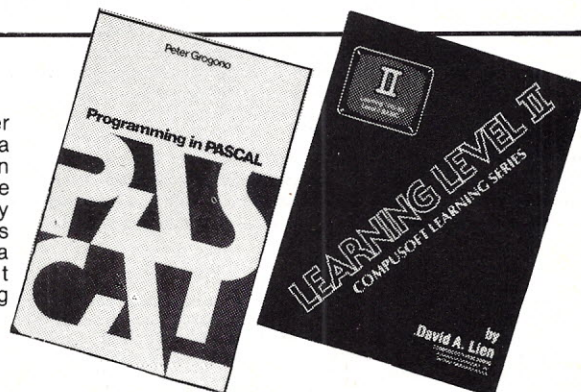
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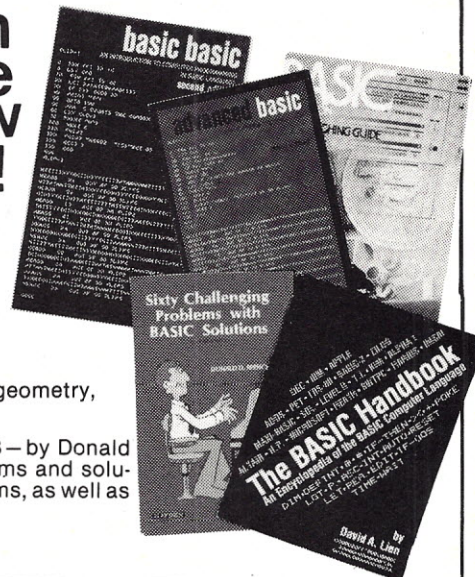
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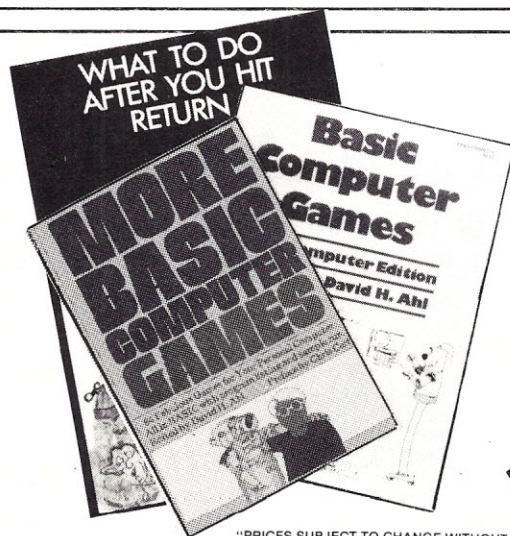


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## MICRO QUIZ

(from page 26)

Answer: 88

I	S	C	A	B
1	1	2	1	2
2	2	3	2	3
3	4	5	3	5
4	7	8	5	8
5	12	13	8	13
6	20	21	13	21
7	33	34	21	34
8	54	55	34	55
9	88	89	55	89

## Playfair

The key to the Challenge Cipher on page 77 is EDGAR ALLEN POE.

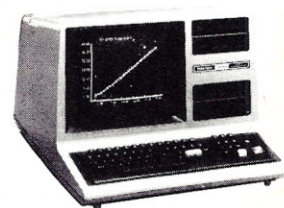
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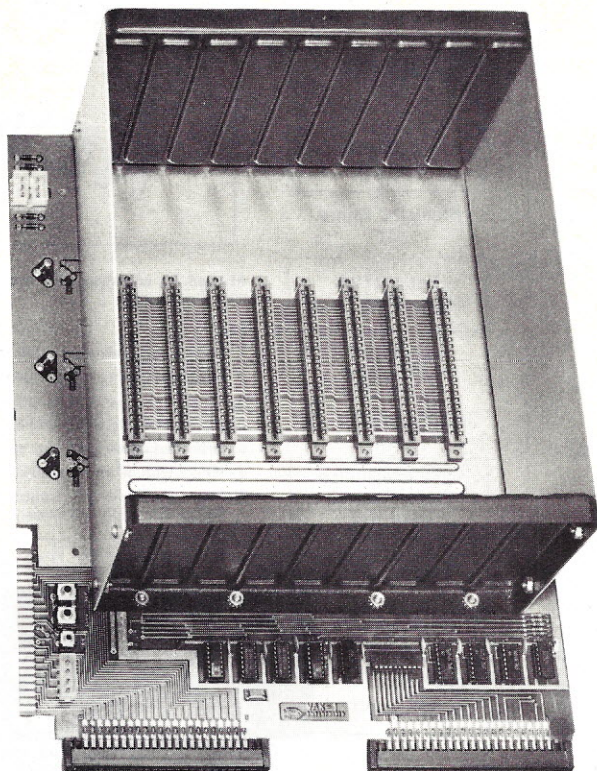
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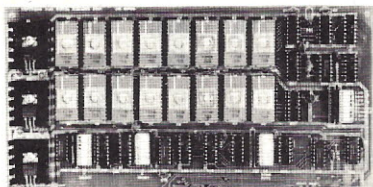


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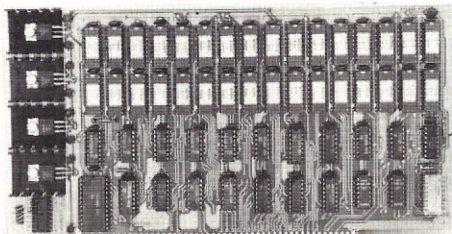
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7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-\$33

LOW PROFILE SOCKET SET-\$12

SUPPORT IC'S & CAPS-\$19.95

ASSEMBLED & TESTED-ADD \$35

**OUR #1 SELLING  
RAM BOARD!**

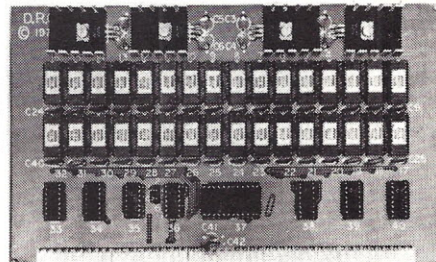
## 16K STATIC RAM SS-50 BUSS

PRICE CUT!

**\$195** KIT

FULLY STATIC!

FOR 2MHZ  
ADD \$10



FOR SWTPC  
6800 BUSS!

ASSEMBLED AND  
TESTED - \$35

### KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout
5. A1 Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD-\$35

COMPLETE SOCKET SET-\$12  
SUPPORT IC'S AND CAPS-\$19.95

**NEW!**

**STEREO!**

## S-100 SOUND COMPUTER BOARD

**NEW!**

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

### KIT FEATURES:

- \* TWO GI SOUND COMPUTER IC'S.
- \* FOUR PARALLEL I/O PORTS ON BOARD.
- \* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- \* ON BOARD PROTO TYPING AREA.
- \* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- \* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
- \* EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
- \* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

### SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M™ compatible diskette or 2708 or 2716. Diskette - \$24.95 2708 - \$19.95 2716 - \$29.95. Diskette includes the source. EPROM'S are ORG at E000H.

COMPLETE KIT!

**\$84<sup>95</sup>**

(WITH DATA MANUAL)

BLANK PC  
BOARD W/DATA  
\$31

## 4K DYNAMIC RAM BLOWOUT!

SAME AS INTEL 2107B!

4K RAMS AT AN UNBELIEVABLE 50¢ EACH!!!

Prime, new, National Semi., 1979 date coded, full spec. parts. N.S. #MM5280-5N. Same as INTEL 2107B-4, T.I. TMS4060, NEC uPD411, etc. We bought a HUGE QTY. from a West Coast Distributor at truly DISTRESS PRICES! One of the most popular and reliable RAM's ever made. These parts have been used by almost all Major Computer Main Frame Mfg. the world over! Arranged as 4K x 1, 270NS Access Time, 22 Pin Dip. These units DO NOT use multiplexed addressing, thus making REFRESH and other timing very simple. See INTEL MEMORY DESIGN HANDBOOK for full application notes. The NAT. SEMI. MEMORY DATA BOOK is available at most Radio Shack Stores. Prime units in original factory tubes!

(With Pin  
Out Data)

#5280-5N 4096 BITS x 1 270 NS ACCESS

8 FOR \$4.95 32 FOR \$16

FACTORY CASE (450 PCS) — \$180

Sockets Special: 22 Pin Low Profile (With Purchase of 5280's) 8 FOR \$1.

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74LS240 - 1.19	Signetics 2901 4 Bit Slice - 6.95
74LS241 - 1.19	AMD 2903 4 Bit Super Slice - 12.50
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AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control, 16 bit Envelope Period Control, 2-8 Bit Parallel I/O, 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **\$11.95 PRICE CUT!**

SPECIAL OFFER: \$14.95 each Add \$3 for 60 page Data Manual.

TERMS: Add \$1.50 postage. We pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa and MasterCard. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50, add 85¢ for insurance.

ALL SALES ARE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

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WE ARE NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

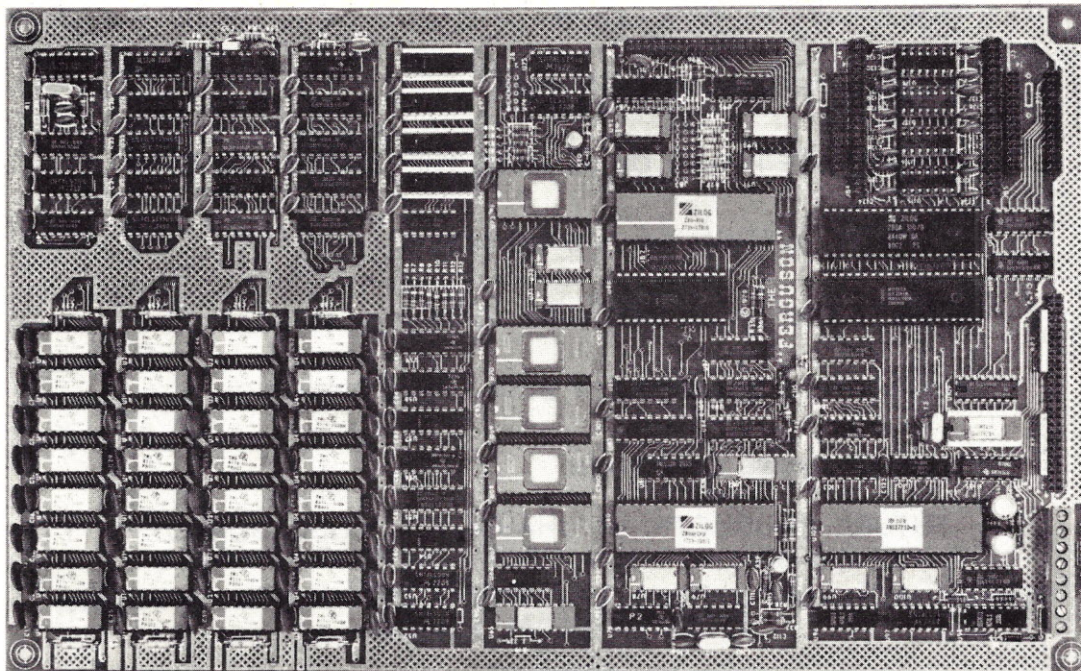


# NEW!

## "THE BIG BOARD" OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC SINGLE BOARD COMPUTER KIT! Z-80 CPU! 64K RAM!

# NEW!

**PARTIAL KIT**  
For All Sockets Installed  
And Soldered Add \$50.



**THE FERGUSON PROJECT:** Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M\*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

**\$649<sup>00</sup>**

(64K KIT  
BASIC I/O)

SIZE: 8 1/2 x 13 3/4 IN.  
SAME AS AN 8 IN. DRIVE.  
REQUIRES: +5V @ 3 AMPS  
+ - 12V @ .5 AMPS.

### FULLY SOCKETED!

### FEATURES: (Remember, all this on one board!)

#### 64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

#### Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software.

#### SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: \$85.

#### BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

#### 24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

#### FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M\* 2.2.

#### TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: \$29.95

#### REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: \$14.95

#### SYSTEM COMPARISON

64K RAM KIT	\$370.00	Talk about bangs per buck! The prices shown for
80 x 24 Video Kit	\$365.00	\$100 kits were taken from the July 1980 BYTE.
Floppy Disk Controller Kit	\$235.00	This will give some basis for comparison between
Z-80 CPU Kit	\$185.95	the Big Board and a similar system implementa-
SER & PAR. I/O	\$129.95	tion on the S100 Buss.
S-100 Mother Board	\$45.00	
SUB TOTAL	\$1330.90	

#### CP/M\* 2.2 FOR BIG BOARD

The popular CP/M\* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for \$150.00.

#### PC BOARD

Blank PC Board with Rom Set and Full Documentation.  
\$195.00

#### PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M\*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.  
Z-80 is a Trademark of Zilog.

## Digital Research Computers

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**TERMS:** Initial shipments will be made approximately 3 to 5 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a \$75 deposit. Balance UPS COD. The \$75 deposit assures your place in line for the initial production run of Big Board.



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NEW CPU-2, Z80 PROCESSOR.

- \* ON BOARD ROM. (2716 OR 2732)
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- \* FRONT PANEL OPERATION.

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16K RAM A&T.		
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64K DYNAMIC A&T.		
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KIT 7490. A & T .....		\$275.00
ARITHMETIC PROCESSOR FOR APPLE 7811A.		
A & T .....		\$342.80
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7710A. A & T .....		\$137.10
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7712A. A & T .....		\$153.95
ALL OTHER CCS PRODUCTS AVAILABLE		



<b>PB-1</b> 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies required. Textool sockets. Kit.....	\$143.00
<b>CB-1A</b> 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status. Kit .....	\$146.00 PCBD ..... \$31.95
<b>VB-3</b> 80x24 VIDEO BOARD. Graphics included. 4MHZ. Kit .....	\$379.95
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<b>VB-IC</b> 64 x 16 video board, upper lower case Greek composite and parallel video with software, S-100. Kit .....	\$143.00
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ALL OTHER SSM PRODUCTS AVAILABLE	



### WAMECO INC.

<b>MEM-3</b> 32K STATIC RAM 2114 24 bit addressing .....	\$36.95
<b>FDC-1</b> FLOPPY CONTROLLER BOARD will drive shugart, pertek, remic 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM™ (not included). PCBD .....	\$43.95
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<b>CPU-1</b> 8080A Processor board S-100 with 8 level vector interrupt. PCBD .....	\$28.95
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<b>PTB-1</b> POWER SUPPLY AND TERMINATOR BOARD. PCBD .....	\$28.95
<b>IOB-1</b> SERIAL AND PARALLEL INTERFACE. 2 parallel, one serial and cassette. PCBD .....	\$28.95
2708.....	\$7.50
2716.....	\$25.95
2114L 450 NSEC .....	\$4.99
2114L 200 NSEC .....	\$5.99

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Please send for IC, Xistor and Computer parts list

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<b>Z80 PROCESSOR WITH MIKOS</b>	
<b>PARTS</b> .....	\$119.95
<b>WAMECO PCBD</b>	
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<b>EPM-2</b> with MIKOS #11 16-32K EPROMS less EPROMS .....	\$65.95
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MIKOS PARTS ASSORTMENTS ARE ALL FACTORY MARKED PARTS. KITS INCLUDE ALL PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED. ALL SOCKETS INCLUDED.	
<b>LARGE SELECTION OF LS TTL AVAILABLE</b>	
PURCHASE \$50.00 WORTH OF LS TTL AND GET 10% CREDIT TOWARD ADDITIONAL PURCHASES. PREPAID ORDERS ONLY.	

VISA or MASTERCHARGE. Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week delay for checks to clear. Calif. residents add 6% tax. Money back 30-day guarantee. We cannot accept returned IC's that have been soldered to. Prices subject to change without notice. \$10 minimum order. \$1.50 service charge on orders less than \$10.00.



# apple II plus apple II

With 48K of memory! \$1199

With 64K of memory! \$1389



## APPLE INTERFACE CARDS

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- DISK II CONTROLLER d.s.s. 3.3 \$199
- INTEGER BASIC PINTURNARE \$195
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- 32K STATIC MEMORY \$299
- 64K DYNAMIC MEMORY \$325
- NOTESBOARD 12 SLOT \$199
- 200 CPU \$299
- RAIDINGBOARD PLUS 6 MEM. \$379
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- 2732 4k x 8 24.95
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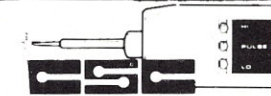
## COLOR



\$397.00 MONITOR 13"

## MSM5832 MICROPROCESSOR REAL-TIME CLOCK/CALENDAR

GENERAL DESCRIPTION  
The MSM5832 is a monolithic, metal-gate CMOS integrated circuit that functions as a real time clock/calendar for use in bus-oriented microprocessor applications. The on-chip 32.768 KHz crystal controlled oscillator time base is counted down to provide addressable 4-bit BCD data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address, chip select, read, write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual 30 second correction.



## 555TIMER 27c

## TMS2716 E-PROM

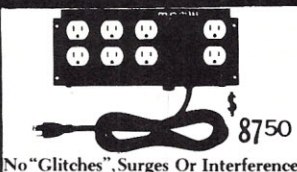
REQUIRES THREE \$850 POWER SUPPS.

## S-100 MEMORY BOARD 16K STATIC RAM

\$269 ASSEMBLED & TESTED  
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## S-100 16K ADD-ON BARE BOARD

\$48.95 WITH DOCUMENTATION AND DETAILED INSTRUCTION BOOK



No "Glitches", Surges Or Interference  
The MPD 117 is the low cost solution to your power distribution problems. The MPD 117 has a high-performance EMI filter, built-in circuit breaker, two direct and six switched outlets, illuminated "on/off" switch for switched outlets, and is built with rugged UL approved components and housing in an all-steel chassis with convenient mounting flanges.



\$17.95 LOGIC PROBE KIT

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- 7918
- 7806
- 7808
- 7812
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- MC1350P 1.15
- MC1358P 1.50
- LM380N 1.75
- NE565M 1.25
- MC1458P .50
- IS410 SCR .95
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- 2114L 200ns 4.25
- 4116 300ns 4.95
- 4116 200ns 5.45

## video 100



\$135 Leedex Corp.  
12" BLACK & WHITE LOW COST VIDEO MONITOR



\$124.95  
apple clock/calendar  
• Seconds, minutes, hours, day-of-week, month, date, & year  
• On board batteries with one year life.  
• Uses MSM5832 crystal controlled.  
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## HEATHKIT® COMPUTER OWNERS WE HAVE H47 COMPATIBLE DISK OPERATING SYSTEM 8" Dual Sided, Double Density Intelligent MASTER/SLAVE

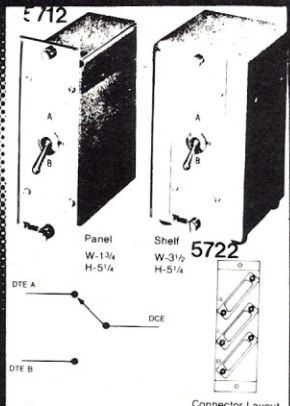
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SN7404N .22	SN7493N .48
SN7408N .24	SN7495N .60
SN7410N .22	SN7496N .70
SN7412N .28	SN74122N .39
SN7413N .35	SN74136N .95
SN7414N .49	SN74141N .69
SN7416N .29	SN74151N .65
SN7417N .29	SN74153N .65
SN7423N .28	SN74154N 1.25
SN7425N .25	SN74155N .80
SN7430N .23	SN74157N .69
SN7437N .29	SN74160N .95
SN7438N .24	SN74161N .65
SN7440N .22	SN74163N .85
SN7442N .57	SN74164N .87
SN7443N .78	SN74165N .87
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SN74451N .20	SN74175N .69
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SN7474N .32	SN74181N 1.15
SN7475N .32	SN74393N 1.69

## TRS 80 16K Memory Add-On \$4395

KIT CONTAINS DIP SWITCHES AND DETAILED INSTRUCTIONS

74LS00	.26
74LS02	.26
74LS03	.26
74LS04	.26
74LS08	.28
74LS09	.26
74LS10	.26
74LS20	.26
74LS21	.28
74LS22	.26
74LS26	.49
74LS27	.26
74LS30	.28
74LS32	.32
74LS38	.32
74LS42	.65
74LS48	.78
74LS51	.25
74LS54	.35
74LS74	.38
74LS75	.60
74LS83	.44
74LS85	.44
74LS86	.95
74LS90	.69
74LS93	.69
74LS107	.45
74LS112	.38
74LS113	.48
74LS122	.48
74LS123	.95
74LS126	.69
74LS138	.69
74LS151	.44
74LS153	.44
74LS155	1.15
74LS158	.75
74LS160	.95
74LS163	1.60
74LS164	.65
74LS165	.65
74LS170	1.75
74LS174	.75
74LS175	.75
74LS190	.75
74LS193	.95
74LS195	.95
74LS196	.85
74LS221	1.40
74LS240	1.65
74LS241	1.65
74LS243	1.45
74LS244	1.45
74LS245	2.25
74LS253	.95
74LS257	.95
74LS258	.95
74LS259	2.85
74LS279	.44
74LS283	1.00
74LS293	1.85
74LS298	1.20
74LS366	.95
74LS367	.55
74LS368	.55
74LS373	1.39
74LS374	1.39



\$145.00 \$155.00

Description  
The RS-232C Compatible Digital Transfer Switch is designed to switch modems between front end processors. All 24 pins of the connector are switched, with Pin 1 wired to ground.



## SOROC TECHNOLOGY, INC.



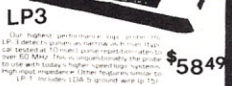
IQ120 \$689  
Global Specialties Logic Probes



LP1 \$37.49



LP2 \$21.49



LP3 \$58.49

## ATARI® 800™ PERSONAL COMPUTER SYSTEM

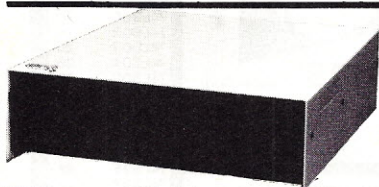


ATARI 800 COMPUTER \$819  
ATARI 400 COMPUTER \$439  
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# SALE SALE SALE

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JADE's new dual disk sub-assemblies include: Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power supply, cooling fan, cable kit, lighted power switch, approved fuse assembly, line cord, Never-Mar rubber feet, and all necessary hardware to mount 2-8" disk drives - it's all American made, guaranteed for six months, and it's in stock!

Dual 8" Sub-Assembly Cabinet

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Single sided, double density disk drive sub-system

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### JADE DISK PACKAGE

Double density controller, two 8" double density floppy disk drives, CP/M 2.2 (configured for controller), hardware and software manuals, boot PROM, cabinet, power supply, fan, & cables

Special package price ..... \$1395.00

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Highly reliable double density floppy disk drives

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## Real Double-Sided Drives 8" Double-Sided Double-Density Sale

\*\*\*\*\*  
\* Shugart SA-851R double-sided, double-density \*  
\* only \$625.00 ea ..... 2 for \$1190.00 \*  
\*\*\*\*\*

MFE M701 8" double-sided, double-density drives

only \$525 ea ..... 2 for \$1040.00

Qume Data Track 8 double-sided, double-density drives  
only \$575.00 ..... 2 for \$1100.00

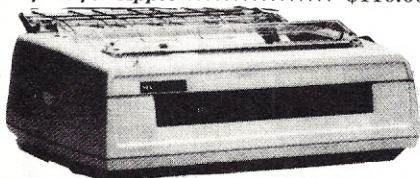
## Printers

### CENTRONICS 737-1

9 x N dot matrix, letter quality, proportional spacing  
PRM-15737 Parallel ..... \$795.00  
With interface for Apple ..... \$895.00

### MX-80 - Epson

132 column, 9 x 9 dot matrix, multiple fonts  
PRM-27080 Save \$100.00 ..... \$545.00  
Interface for Apple ..... \$110.00



### SPINWRITER - NEC

65 cps, bi-directional, letter quality printer with deluxe tractor mechanism, both parallel and serial interfaces on-board, 16K buffer, ribbon, print thimble, graphics, micro space justification, data cable, and self test/diagnostic ROM.

PRD-55511 without 16K buffer ... \$2795.00  
PRD-55512 with 16K buffer ..... \$2895.00

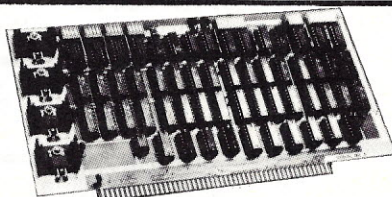
## S-100 Systems

### S-100 SYSTEM - Calif Computer Sys

Complete S-100 system including 12 slot mainframe, 4 MHz Z-80 CPU, 64K RAM memory, double density disk controller, RS-232 cable, 8" & 5 1/4" disk drive cables, CP/M 2.2, manuals, auto boot ROM, completely assembled & tested.

2210A Integrated & tested ..... \$1995.00  
2210B Not integrated ..... \$1795.00

## S-100 Memory



### 64K RAM - Calif Computer Sys

4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A A & T ..... \$449.95

### MEMORY BANK - Jade

4 MHz, IEEE S-100, bank selectable, 8 or 16 bit

MEM-99730B Bare board ..... \$55.00  
MEM-99730K Kit, no RAM ..... \$219.95  
MEM-16730K 16K kit ..... \$249.95  
MEM-32731K 32K kit ..... \$289.95  
MEM-48732K 48K kit ..... \$324.95  
MEM-64733K 64K kit ..... \$359.95  
Assembled & tested ..... add \$50.00

### EXPANDORAM II - S D Systems

4 MHz RAM board expandable from 16K to 256K

MEM-16630K 16K kit ..... \$275.95  
MEM-32631K 32K kit ..... \$295.95  
MEM-48632K 48K kit ..... \$315.95  
MEM-64633K 64K kit ..... \$335.95  
Assembled & tested ..... add \$50.00

### 32K STATIC RAM - Jade

2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K 16K 4 MHz kit ..... \$169.95  
MEM-32151K 32K 4 MHz kit ..... \$299.95  
Assembled & tested ..... add \$50.00

### 16K STATIC RAM - Cal Comp Sys

2 or 4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks

MEM-16160A 16K 2 MHz A & T ... \$286.95  
MEM-16162A 16K 4 MHz A & T ... \$289.95  
MEM-16160B Bare board ..... \$50.00

### PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer  
MEM-99510K Kit ..... \$154.95  
MEM-99510A A & T ..... \$229.95

### PROM-100 - SD Systems

2708, 2716, 2732, 2758, & 2516 EPROM programmer  
MEM-99520K Kit ..... \$219.95  
MEM-99520A Jade A & T ..... \$269.95

## S-100 Video

### VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K 4 MHz kit ..... \$375.00  
IOV-1095A 4 MHz A & T ..... \$450.00  
IOV-1096K 80 x 48 upgrade ..... \$39.95

### VIDEO BOARD - Jade

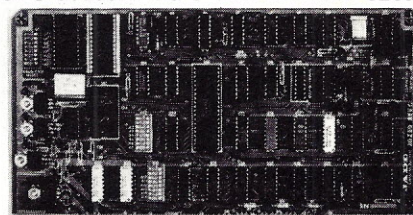
64 characters x 16 lines, 7 x 9 dot matrix, full upper / lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1050K Kit ..... \$99.95  
IOV-1050A A & T ..... \$125.00  
IOV-1050B Bare board ..... \$19.95

## S-100 CPU

### 2810 Z-80\* CPU - Cal Comp Sys

2/4 MHz Z-80A\* CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.  
CPU-30400A A & T ..... \$269.95



### THE BIG Z\* - Jade

2 or 4 MHz switchable Z-80\* CPU with serial I/O, accommodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600

CPU-30201K Kit ..... \$145.00  
CPU-30201A A & T ..... \$199.00  
CPU-30200B Bare board ..... \$35.00

### CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300A A & T ..... \$229.95

### SBC-200 - SD Systems

4 MHz Z-80\* CPU with serial & parallel I/O ports, up to 8K of on-board PROM, software programmable baud rate generator, 1K of on-board RAM, Z-80 CTC.

CPC-30200K Kit ..... \$339.95  
CPC-30200A Jade A & T ..... \$399.95

## S-100 Disk Controller

### DOUBLE DENSITY - Cal Comp Sys

5 1/4" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2\* and manual set.

IOD-1300A A & T ..... \$369.95

### DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A\*, printer port, IEEE S-100, can function on an interrupt driven buss

IOD-1200K Kit ..... \$299.95  
IOD-1200A 8" A & T ..... \$389.95  
IOD-1205A 5 1/4" A & T ..... \$389.95  
IOD-1200B Bare board ..... \$65.00

### VERSAFLOPPY II - SD Systems

New double density controller for both 8" & 5 1/4"  
IOD-1160K Kit ..... \$379.95  
IOD-1160A Jade A & T ..... \$439.95

## Motherboards

### ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard  
6 Slot (5 1/4" x 8 1/2")

MBS-061B Bare board ..... \$19.95  
MBS-061K Kit ..... \$39.95  
MBS-061A A & T ..... \$49.95

12 Slot (9 1/4" x 8 1/2")

MBS-121B Bare board ..... \$29.95  
MBS-121K Kit ..... \$69.95  
MBS-121A A & T ..... \$89.95

18 Slot (14 1/2" x 8 1/2")

MBS-181B Bare board ..... \$49.95  
MBS-181K Kit ..... \$99.95  
MBS-181A A & T ..... \$139.95

## Card Cages

### S-100 CARD CAGE - Jade

Metal cage with card guides & fan mounting  
ENX-106001 Six slot ..... \$29.95

### S-100 CARD CAGE - Vector

19" rack mountable, adjustable, holds 21 cards  
VCT-CCK100 Anodized Al ..... \$49.95



# SALE

## S-100 I/O

### S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K 2 CTC's, 1 SIO, 1 PIO .. \$199.00  
 IOI-1045A A & T .. \$259.00  
 IOI-1046K 4 CTC's, 2 SIO's, 1 PIO .. \$259.00  
 IOI-1046A A & T .. \$319.00  
 IOI-1045B Bare board w/ manual .. \$59.95  
 IOI-1045D Manual only .. \$20.00

### I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K Kit .. \$179.95  
 IOI-1010A A & T .. \$249.95  
 IOI-1010B Bare board .. \$35.00

### TERMINATOR - S.S.M.

Active terminator for S-100 bus

TSX-195K Kit .. \$29.95  
 TSX-195A A & T .. \$54.95  
 TSX-195B Bare board .. \$22.95

### S-100 EXTENDER - Cal Comp Sys

Put those problem boards (the ones you probably bought from one of our competitors) within easy reach.

TSX-160A A & T .. \$37.95

### S-100 PROTO BOARD - Jade

Universal design, plated thru holes, gold fingers

TSX-140B Bare board .. \$24.95

### TERMINATOR & EXTENDER - C.C.S.

Can be used as both an S-100 extender and terminator

TSX-150K Kit .. \$43.95

## Diskettes

### DISKETTES - Jade

Bargain prices on magnificent magnetic media

5 1/4" single sided, single density, box of 10

MMD-5110103 Soft sector .. \$27.95  
 MMD-5111003 10 sector .. \$27.95  
 MMD-5111603 16 sector .. \$27.95

5 1/4" double sided, double density, box of 10

MMD-5220103 Soft sector .. \$39.95

8" single sided, single density, box of 10

MMD-8110103 Soft sector .. \$33.95

8" single sided, double density, box of 10

MMD-8120103 Soft sector .. \$39.95

8" double sided, double density, box of 10

MMD-8220103 Soft sector .. \$49.95

## Video Monitors

### 9" B & W MONITOR - A.P.F.

High quality, high resolution video monitor

VDM-750900 9" monitor .. \$159.95

### 13" COLOR MONITOR - Zenith

The hi res color you've been promising yourself

VDC-201301 .. \$449.00

### 12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200 12" monitor .. \$259.95

## Mainframes

### MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

ENC-112105 Kit .. \$359.95  
 ENC-112106 A & T .. \$419.95

### DISK MAINFRAME - NNC

Holds 2 8" drives and an 8 slot S-100 system. Attractive metal cabinet with 8 slot motherboard, power supply, fan, key switch, and other professional features

ENS-112320 with 30 amp p.s. .... \$699.95

## Accessories-Apple/TRS-80



### 16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

MEX-16100K TRS-80 kit .. \$29.00  
 MEX-16101K Apple kit .. \$29.00  
 MEX-16102K Exidy kit .. \$29.00

### DISK DRIVE for APPLE

5 1/4" disk drive with controller for your Apple

MSM-12310C with controller .. \$499.95  
 MSM-123101 w/out controller .. \$375.00

### DISK DRIVES for TRS-80

23% more storage, 8 times faster, 40 track with free patch, 120 day warranty, includes case, power supply, and cable

MSM-12410C Save \$125.00 !!! .. \$299.95

### DOS 3.3 UPGRADE - Apple

Upgrade your old DOS to the improved 3.3

IOD-2233A Complete kit .. \$64.95

### APPLE STICK - Micromate

Joy stick with pots for Apple II

SYA-1510A A & T .. \$35.95

### Z-80\* CARD for APPLE

Z-80\* CPU card with CP/M 2.2 for your Apple

CPX-30800A A & T .. \$279.95

### AIO - S.S.M.

Parallel & serial interface for your Apple

IOI-2050K Kit .. \$155.95  
 IOI-2050A A & T .. \$194.95

### PRINTER INTERFACE - C.C.S.

Centronics type I/O card w/ firmware

IOI-2041A A & T .. \$99.95

### APPLE CLOCK - Cal Comp Sys

Real time clock w/battery back-up

IOK-2100A A & T .. \$109.95

## Modems

\*\*\*\*\*

**LEX-11 MODEM - Lexicon**

A real star! 300 baud, answer/originate, RS 232C

IOM-5511A Best buy !!! .. \$128.00

\*\*\*\*\*

### NOVATION CAT

300 baud, answer/originate acoustic modem

IOM-5200A 1 year warranty .. \$179.00

### D-CAT 300 baud, direct connect modem

IOM-5201A Special sale price .. \$189.00

### AUTO-CAT Auto answer/originate, direct connect

IOM-5230A Special sale price .. \$239.95

### MICROMODEM - D.C. Hayes

Auto answer/dial modem card for Apple or S-100

IOM-2010A Apple modem .. \$349.95  
 IOM-1100A S-100 modem .. \$375.00

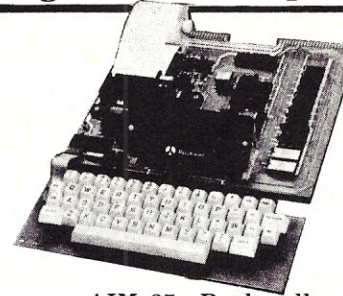
### MICRONET MODEM - Micromate

Direct connect with extra features - a best buy

IOM-2020A Best Apple modem .... \$275.00

\* Z-80, Z-80A, and the letter Z are recognized trademarks of Zilog, Inc. \*CP/M is a registered trademark of Digital Research Corp. \*CBASIC is a trademark of Compiler Systems, Inc.

## Single Board Computers



### AIM-65 - Rockwell

6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals

CPK-50165 1K AIM .. \$374.95  
 CPK-50465 4K AIM .. \$449.95  
 SFK-74600008E 8K BASIC ROM .. \$99.95  
 SFK-64600004E 4K assembler ROM .. \$84.95  
 PSX-030A Power supply .. \$64.95  
 ENX-000002 Enclosure .. \$49.95

4K AIM, 8K BASIC, power supply, & enclosure

Special package price .. \$625.00

### Z-80\* STARTER KIT - SD Systems

Complete Z-80\* computer with RAM, ROM, I/O, display, keyboard, manual, and kluge area.

CPS-30010K Kit .. \$369.95  
 CPS-30010A Jade A & T .. \$459.95

### MICROPROCESSORS

Z-80 .. 10.95	2708 450ns .. 6.25
Z-80A .. 12.95	10 for \$4.90 ea
6502 .. 11.50	2716 12.5v .. 11.95
6800 .. 11.95	2716 5v .. 11.95
6802 .. 17.95	10 for \$8.90 ea
6809 .. 39.95	2532 5v .. 39.95
8035 .. 24.00	2732 5v .. 39.95
8080A .. 6.59	2758 5v .. 9.95
8085 .. 15.95	
8748 .. 59.95	

### PROMS

Z-80 SUPPORT	21102 2 MHz .. 1.25
3881 PIO .. 9.50	21102A 4 MHz .. 1.50
3881A PIO4 MHz .. 14.50	2114L 2 MHz .. 3.75
3882 CTC .. 9.50	2114LA 4 MHz .. 3.95
3882A CTC4 MHz .. 14.95	4116 .. 4.25
3883 SIO .. 29.50	4164 64K x1 .. 59.95
3884 SIO .. 49.50	5257 2 MHz .. 6.75
	5257A 4 MHz .. 7.25
	MK4118 .. 18.95

### BAUD RATE

GENERATORS	SUPPORT DEVICES
MC14411 .. 10.00	8212 .. 3.25
1.843 MHz xtal .. 4.95	8214 .. 4.65

### UARTS

AY5-1013A .. 5.25	8216 .. 2.95
AY3-1014A .. 8.25	8224 .. 3.25
TR1602B .. 5.25	8224-4 .. 5.75
TMS6011 .. 5.95	8226 .. 3.85
IM6402 .. 9.00	8228 .. 4.95
	8238 .. 4.95
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# 16K MEMORY — \$24.00

FOR APPLE - TRS-80 - EXIDY - S100

4116 EQUIVALENT

2114-300ns

NATIONAL MM5290N-3 .....200ns 8for\$ 24.00

NATIONAL MM2114N-3L .....8for\$ 26.00



## IMSAI COMPATIBLE PRODUCTS



### I-8080 S-100 ENCLOSURE Sheet Metal Kit

Just like THE ORIGINAL IMSAI: Mainframe with blue cover, cardguides and hardware spaced for PS-28D Power Supply, up to 22 slot motherboard.

*Kit of all metal parts and hardware with documentation* ..... \$115.00

*Thinker Toys WunderBuss 20 for above w/o conn.* ..... \$ 79.00

*AMPS-100 Connectors—each*... \$ 3.50

*8015 Blank jump-start panel w/3 switches* ..... \$ 32.50

*8035 Jump start panel for 2 SA-400\$* 78.50

### PS-28D Power Supply Parts Kit:

Mounts in the I-8080 enclosure, supplies +8V @ 28A, +/— 16V @ 3A, kit includes board, transformer, documentation, and all components. Improved from original.

*Kit* ..... \$ 95.50

### PIO 4-4

4 parallel inputs and outputs (8212) ... \$160.00

### SIO 2-2

2 serial I/O ports, good to 19,200 baud . \$175.00

### DIO-C/D

### CPM® 2.2

### CPA

2 board disk controller for 8" or 5¼" ... \$350.00

For DIO including documentation ... \$175.00

Improved Imsai style front panel works with Z80, etc. .... \$225.00

8080 processor board—requires CPA . \$100.00

8085 3MHz processor SBC w/serial plus parallel port, monitor ..... \$250.00

### RAM III 64K MEMORY

64K byte dynamic RAM board—Utilizes the Intel 3242 refresh controller and a single delay line for totally internal refresh. Uses time proven 4116 RAMS. Memory mapped I/O boards are allowed to coexist by the use of A16 buss pin 16.

*Assembled & Tested* ..... \$350.00

*Bare Board w/docs* ..... \$ 40.00

### IKB-1

### MDX

### DE 8

Intelligent keyboard uses 8035 ..... \$149.50

Dual SA400 drive enclosure ..... \$ 75.00

Dual 800R/801R horizontal style enclosure w/power supply and fan ..... \$240.00

*Case Only*..... \$100.00

## COMPLETE SYSTEMS

### I-8080 SYSTEM

The basic 8080 based S-100 system. Includes CPA front panel, 22 slot motherboard (with all 22 connectors), MPU-A 8080 CPU board, PS-28D power supply (+8V @ 28A, +/— 16V @ 3A), and chassis. COMPLETELY ASSEMBLED & TESTED.

*With MPU-A* ..... \$650.00

*Without MPU-A* ..... \$600.00

*Thinker Toys 10MHz WunderBuss add* ..... \$ 75.00

### I-8015 Complete System w/MPU-B

The complete 8085 system, includes MPU-B, RAM III, 10 slot terminated motherboard, PS-28D, and jump start front panel. A complete 64K system!

*Assembled & Tested* ..... \$1250.00

### I-8035

The complete 8085 system w/2 each TANDON TM-100, DIO-D, MPU-B, RAM III, chassis, 10 slot motherboard and power supply. Includes CPM® 2.2.

*Assembled & Tested* ..... \$2295.00

### VDP-40

Desk-top 8085 micro-computer system with keyboard, 9" CRT display, 10 slot S-100 board, disk controller, 64K dynamic RAM, 2 each TANDON 5¼" disk drives, 28 amp power supply.

*Assembled & Tested* ..... \$2895.00

### DS-8

Dual 801R horizontal style 8" disk enclosure w/power supply, fan, and 2 Shugart 801R drives.

*Assembled & Tested* ..... \$1100.00

*Above w/DIO-C & CPM 2.2* ..... \$1500.00

Ask about documentation, repair service, firmware and software for your system.



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7400N	LM320K-12	1.35	CD4027	.66	4116 200ms	4.50
7400N	LM320K-15	1.35	CD4028	.85	84116 200ms	26.95
7400N	LM320K-18	1.35	CD4029	1.30	MM5202	4.50
7400N	LM320K-22	1.35	CD4030	.45	MM5280	3.00
7400N	LM320K-25	1.35	CD4031	.50	MM5320	9.95
7400N	LM320K-28	1.35	CD4032	1.35	MM5330	5.94
7400N	LM320K-32	1.35	CD4033	.85	PD4110-3	4.00
7400N	LM320K-35	1.35	CD4034	.85	PD4110-4	5.00
7400N	LM320K-38	1.35	CD4035	.85	PS1011	8.95
7400N	LM320K-41	1.35	CD4036	1.67	4200A	9.95
7400N	LM320K-44	1.35	CD4037	.40	8225Z	2.90
7400N	LM320K-47	1.35	CD4038	.40	91L02A	1.50
7400N	LM320K-50	1.35	CD4039	1.12	100 pin edge WW	5.25
7400N	LM320K-53	1.35	CD4040	.42	MM5200	4.50
7400N	LM320K-56	1.35	CD4041	.71	MM5200-1	9.95
7400N	LM320K-59	1.35	CD4042	.40	MM5200-5	9.95
7400N	LM320K-62	1.35	CD4043	.40	MM5200-5	9.95
7400N	LM320K-65	1.35	CD4044	.40	MM5200-5	9.95
7400N	LM320K-68	1.35	CD4045	.40	MM5200-5	9.95
7400N	LM320K-71	1.35	CD4046	.40	MM5200-5	9.95
7400N	LM320K-74	1.35	CD4047	.40	MM5200-5	9.95
7400N	LM320K-77	1.35	CD4048	.40	MM5200-5	9.95
7400N	LM320K-80	1.35	CD4049	.40	MM5200-5	9.95
7400N	LM320K-83	1.35	CD4050	.40	MM5200-5	9.95
7400N	LM320K-86	1.35	CD4051	.40	MM5200-5	9.95
7400N	LM320K-89	1.35	CD4052	.40	MM5200-5	9.95
7400N	LM320K-92	1.35	CD4053	.40	MM5200-5	9.95
7400N	LM320K-95	1.35	CD4054	.40	MM5200-5	9.95
7400N	LM320K-98	1.35	CD4055	.40	MM5200-5	9.95
7400N	LM320K-101	1.35	CD4056	.40	MM5200-5	9.95
7400N	LM320K-104	1.35	CD4057	.40	MM5200-5	9.95
7400N	LM320K-107	1.35	CD4058	.40	MM5200-5	9.95
7400N	LM320K-110	1.35	CD4059	.40	MM5200-5	9.95
7400N	LM320K-113	1.35	CD4060	.40	MM5200-5	9.95
7400N	LM320K-116	1.35	CD4061	.40	MM5200-5	9.95
7400N	LM320K-119	1.35	CD4062	.40	MM5200-5	9.95
7400N	LM320K-122	1.35	CD4063	.40	MM5200-5	9.95
7400N	LM320K-125	1.35	CD4064	.40	MM5200-5	9.95
7400N	LM320K-128	1.35	CD4065	.40	MM5200-5	9.95
7400N	LM320K-131	1.35	CD4066	.40	MM5200-5	9.95
7400N	LM320K-134	1.35	CD4067	.40	MM5200-5	9.95
7400N	LM320K-137	1.35	CD4068	.40	MM5200-5	9.95
7400N	LM320K-140	1.35	CD4069	.40	MM5200-5	9.95
7400N	LM320K-143	1.35	CD4070	.40	MM5200-5	9.95
7400N	LM320K-146	1.35	CD4071	.40	MM5200-5	9.95
7400N	LM320K-149	1.35	CD4072	.40	MM5200-5	9.95
7400N	LM320K-152	1.35	CD4073	.40	MM5200-5	9.95
7400N	LM320K-155	1.35	CD4074	.40	MM5200-5	9.95
7400N	LM320K-158	1.35	CD4075	.40	MM5200-5	9.95
7400N	LM320K-161	1.35	CD4076	.40	MM5200-5	9.95
7400N	LM320K-164	1.35	CD4077	.40	MM5200-5	9.95
7400N	LM320K-167	1.35	CD4078	.40	MM5200-5	9.95
7400N	LM320K-170	1.35	CD4079	.40	MM5200-5	9.95
7400N	LM320K-173	1.35	CD4080	.40	MM5200-5	9.95
7400N	LM320K-176	1.35	CD4081	.40	MM5200-5	9.95
7400N	LM320K-179	1.35	CD4082	.40	MM5200-5	9.95
7400N	LM320K-182	1.35	CD4083	.40	MM5200-5	9.95
7400N	LM320K-185	1.35	CD4084	.40	MM5200-5	9.95
7400N	LM320K-188	1.35	CD4085	.40	MM5200-5	9.95
7400N	LM320K-191	1.35	CD4086	.40	MM5200-5	9.95
7400N	LM320K-194	1.35	CD4087	.40	MM5200-5	9.95
7400N	LM320K-197	1.35	CD4088	.40	MM5200-5	9.95
7400N	LM320K-200	1.35	CD4089	.40	MM5200-5	9.95
7400N	LM320K-203	1.35	CD4090	.40	MM5200-5	9.95
7400N	LM320K-206	1.35	CD4091	.40	MM5200-5	9.95
7400N	LM320K-209	1.35	CD4092	.40	MM5200-5	9.95
7400N	LM320K-212	1.35	CD4093	.40	MM5200-5	9.95
7400N	LM320K-215	1.35	CD4094	.40	MM5200-5	9.95
7400N	LM320K-218	1.35	CD4095	.40	MM5200-5	9.95
7400N	LM320K-221	1.35	CD4096	.40	MM5200-5	9.95
7400N	LM320K-224	1.35	CD4097	.40	MM5200-5	9.95
7400N	LM320K-227	1.35	CD4098	.40	MM5200-5	9.95
7400N	LM320K-230	1.35	CD4099	.40	MM5200-5	9.95
7400N	LM320K-233	1.35	CD4100	.40	MM5200-5	9.95
7400N	LM320K-236	1.35	CD4101	.40	MM5200-5	9.95
7400N	LM320K-239	1.35	CD4102	.40	MM5200-5	9.95
7400N	LM320K-242	1.35	CD4103	.40	MM5200-5	9.95
7400N	LM320K-245	1.35	CD4104	.40	MM5200-5	9.95
7400N	LM320K-248	1.35	CD4105	.40	MM5200-5	9.95
7400N	LM320K-251	1.35	CD4106	.40	MM5200-5	9.95
7400N	LM320K-254	1.35	CD4107	.40	MM5200-5	9.95
7400N	LM320K-257	1.35	CD4108	.40	MM5200-5	9.95
7400N	LM320K-260	1.35	CD4109	.40	MM5200-5	9.95
7400N	LM320K-263	1.35	CD4110	.40	MM5200-5	9.95
7400N	LM320K-266	1.35	CD4111	.40	MM5200-5	9.95
7400N	LM320K-269	1.35	CD4112	.40	MM5200-5	9.95
7400N	LM320K-272	1.35	CD4113	.40	MM5200-5	9.95
7400N	LM320K-275	1.35	CD4114	.40	MM5200-5	9.95
7400N	LM320K-278	1.35	CD4115	.40	MM5200-5	9.95
7400N	LM320K-281	1.35	CD4116	.40	MM5200-5	9.95
7400N	LM320K-284	1.35	CD4117	.40	MM5200-5	9.95
7400N	LM320K-287	1.35	CD4118	.40	MM5200-5	9.95
7400N	LM320K-290	1.35	CD4119	.40	MM5200-5	9.95
7400N	LM320K-293	1.35	CD4120	.40	MM5200-5	9.95
7400N	LM320K-296	1.35	CD4121	.40	MM5200-5	9.95
7400N	LM320K-299	1.35	CD4122	.40	MM5200-5	9.95
7400N	LM320K-302	1.35	CD4123	.40	MM5200-5	9.95
7400N	LM320K-305	1.35	CD4124	.40	MM5200-5	9.95
7400N	LM320K-308	1.35	CD4125	.40	MM5200-5	9.95
7400N	LM320K-311	1.35	CD4126	.40	MM5200-5	9.95
7400N	LM320K-314	1.35	CD4127	.40	MM5200-5	9.95
7400N	LM320K-317	1.35	CD4128	.40	MM5200-5	9.95
7400N	LM320K-320	1.35	CD4129	.40	MM5200-5	9.95
7400N	LM320K-323	1.35	CD4130	.40	MM5200-5	9.95
7400N	LM320K-326	1.35	CD4131	.40	MM5200-5	9.95
7400N	LM320K-329	1.35	CD4132	.40	MM5200-5	9.95
7400N	LM320K-332	1.35	CD4133	.40	MM5200-5	9.95
7400N	LM320K-335	1.35	CD4134	.40	MM5200-5	9.95
7400N	LM320K-338	1.35	CD4135	.40	MM5200-5	9.95
7400N	LM320K-341	1.35	CD4136	.40	MM5200-5	9.95
7400N	LM320K-344	1.35	CD4137	.40	MM5200-5	9.95
7400N	LM320K-347	1.35	CD4138	.40	MM5200-5	9.95
7400N	LM320K-350	1.35	CD4139	.40	MM5200-5	9.95
7400N	LM320K-353	1.35	CD4140	.40	MM5200-5	9.95
7400N	LM320K-356	1.35	CD4141	.40	MM5200-5	9.95
7400N	LM320K-359	1.35	CD4142	.40	MM5200-5	9.95
7400N	LM320K-362	1.35	CD4143	.40	MM5200-5	9.95
7400N	LM320K-365	1.35	CD4144	.40	MM5200-5	9.95
7400N	LM320K-368	1.35	CD4145	.40	MM5200-5	9.95
7400N	LM320K-371	1.35	CD4146	.40	MM5200-5	9.95
7400N	LM320K-374	1.35	CD4147	.40	MM5200-5	9.95
7400N	LM320K-377	1.35	CD4148	.40	MM5200-5	9.95
7400N	LM320K-380	1.35	CD4149	.40	MM5200-5	9.95
7400N	LM320K-383	1.35	CD4150	.40	MM5200-5	9.95
7400N	LM320K-386	1.35	CD4151	.40	MM5200-5	9.95
7400N	LM320K-389	1.35	CD4152	.40	MM5200-5	9.95
7400N	LM320K-392	1.35	CD4153	.40	MM5200-5	9.95
7400N	LM320K-395	1.35	CD4154	.40	MM5200-5	9.95
7400N	LM320K-398	1.35	CD4155	.40	MM5200-5	9.95
7400N	LM320K-401	1.35	CD4156	.40	MM5200-5	9.95
7400N	LM320K-404	1.35	CD4157	.40	MM5200-5	9.95
7400N	LM320K-407	1.35	CD4158	.40	MM5200-5	9.95
7400N	LM320K-410	1.35	CD4159	.40	MM5200-5	9.95
7400N	LM320K-413	1.35	CD4160	.40	MM5200-5	9.95
7400N	LM320K-416	1.35	CD4161	.40	MM5200-5	9.95
7400N	LM320K-419	1.35	CD4162	.40	MM5200-5	9.95
7400N	LM320K-422	1.35	CD4163	.40	MM5200-5	9.95
7400N	LM320K-425	1.35	CD4164	.40	MM5200-5	9.95
7400N	LM320K-428	1.35	CD4165	.40	MM5200-5	9.95
7400N	LM320K-431	1.35	CD4166	.40	MM5200-5	9.95
7400N	LM320K-434	1.35	CD4167	.40	MM5200-5	9.95
7400N	LM320K-437	1.35	CD4168	.40	MM5200-5	9.95
7400N	LM320K-440	1.35	CD4169	.40	MM5200-5	9.95
7400N	LM320K-443	1.35	CD4170	.40	MM5200-5	9.95
7400N	LM320K-446	1.35	CD4171	.40	MM5200-5	9.95
7400N	LM320K-449	1.35	CD4172	.40	MM5200-5	9.95
7400N	LM320K-452	1.35	CD4173	.40	MM5200-5	9.95
7400N	LM320K-455	1.35	CD4174	.40	MM5200-5	9.95
7400N	LM320K-458	1.35	CD4175	.40	MM5200-5	9.95
7400N	LM320K-461	1.35	CD4176	.40	MM5200-5	9.95
7400N	LM320K-464	1.35	CD4177	.40	MM5200-5	9.95
7400N	LM320K-467	1.35	CD4178	.40	MM5200-5	9.95
7400N	LM320K-470	1.35	CD4179	.40	MM5200-5	9.95
7400N	LM320K-473	1.35	CD4180	.40	MM5200-5	9.95
7400N	LM320K-476	1.35	CD4181	.40	MM5200-5	9.95
7400N	LM320K-479	1.35	CD4182	.40	MM5200-5	9.95
7400N	LM320K-482	1.35	CD4183	.40	MM5200-5	9.95
7400N	LM320K-4					



Part No.	Function	Price
70551PI	CMOS Precision Timer	14.95
7056E/V/Kit*	Stopwatch Chip, XTL	22.95
7106CPL	3% Digit A/D (LCD Drive)	16.95
7106E/V/Kit*	1C, Circuit Board, Display	34.95
7107CPL	3% Digit A/D (LED Drive)	15.95
7107E/V/Kit*	1C, Circuit Board, Display	28.95
7116CPL	3% Digit A/D LCD DS. H.LD.	18.95
7117CPL	3% Digit A/D LED DS. H.LD.	17.95
7201DR	Low Battery Volt Indicator	2.25
7205CPL	LED Stop Watch/Timer	12.95
7205E/V/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206E/V/Kit*	Tone Generator Chip, XTL	9.95
7207CPL	7 Segment Counter, Controls	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	11.10
72081PI	Seven Decade Counter	17.95
72091PIA	Clock Generator	3.95
72159PG	4 Func. CMOS Stopwatch CKT	13.95
7216E/V/Kit*	4 Func. CMOS Stopwatch Chip, XTL	15.95
7216A1J1	8-Digit Univ. Counter C.A.	32.00
7216C1J1	8-Digit Freq. Counter C.A.	26.95
7216D1J1	8-Digit Freq. Counter C.C.	21.95
7217CPL	8-Digit LED Up/Down Counter	12.95
7218C1J1	8-Digit Univ. LED Drive	10.95

7221PL	LCD 4½ Digit Up Counter	DR1	11.25																																																																																
7225A1JL	8-Digit Univ. Counter		31.95																																																																																
7225A5V/KIT*	5 Function Counter Chp. XTL		74.95																																																																																
7230JLE	CMOS Bin Prog. Timer/Counter		4.95																																																																																
7242J1A	CMOS Divide-by-256 RC Timer		2.00																																																																																
7250JLE	CMOS BCD Prog. Timer/Counter		6.00																																																																																
7260JLE	CMOS BCD Prog. Timer/Counter		5.25																																																																																
7265IPA	CMOS 555 Timer (8 pin)		2.50																																																																																
72661PD	CMOS 556 Timer (14 pin)		2.20																																																																																
7611BCPA	CMOS Op Amp Comparator	5MV/2.25																																																																																	
7612BCPA	CMOS Op Amp Ext. Cmpv.	5MV/2.95																																																																																	
7613BCPA	CMOS Dual Op Amp Cmpv.	5MV/3.95																																																																																	
7614BCPA	CMOS Tri Op Amp Cmpv.	10MV/5.55																																																																																	
7614ICPD	CMOS Quad Op Amp Comp.	10MV/5.50																																																																																	
7642CPD	CMOS Quad Op Amp Comp.	10MV/7.50																																																																																	
7660CPA	Voltage Converter		2.95																																																																																
8069CCQ	500pp Bandwidth V. Ref. Diode		2.50																																																																																
8100CQ	Volt/Ref/Indicator		2.50																																																																																
8212CPA	Volt Ref/Indicator		2.50																																																																																
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LT07C1P	7.79	LM340T-12	1.25	LM710N	1.79
LT07ZCP	1.29	LM340T-15	1.25	LM717N	-.69
LT0741P	2.49	LM340T-15	1.25	LM717N	-.69
LT0808CD	35.80	LM343P-12	1.25	LM7533N	1.00
LT082CP	1.19	LM343P-15	1.75	LM739N	1.19
LT084CN	1.29	LM343P-15	.69	LM741CN	1.35
LT0908CD	36.80	LM343P-12	.69	MC1741SCG	3.00
LM0010N	2.99	LM343P-15	.69	LM741N	1.75
LM301CN	1.35	LM348N	1.25	LM748N	-.55
LM302H	1.95	LM350K	5.75	LM1041N	2.75
LM304H	1.95	LF351N	.60	LM1310N	1.95
LM305H	1.95	LF353N	1.00	LM148CN	.55
LM306H	.45	LF355A	1.10	LM148N	1.25
LM308CN	1.00	LF356N	1.10	LM1489N	1.25
LM309H	1.95	LM358N	1.00	LM1496N	1.95
LM309K	1.25	LM359N	1.79	LM1556V	1.75
LM310H	1.75	LM373N	1.40	LM1562N	2.95
LM311H	.90	LM373N	1.25	LM1877N	3.25
LM312H	2.49	LM377N	2.95	LM1889N	3.20
LM317MP	1.15	LM380N	1.25	LM1896N	1.75
LM317T	1.75	LM381N	1.95	LM2002T	1.45
LM318N	1.95	LM382N	1.79	LM2028N	2.05
LM318CN	1.95	LM384N	1.95	LM2878P	2.25
LM319N	1.95	LM388N-3	1.29	LM2896P-1	2.25
LM320N	1.35	LM387N	1.45	LM3189N	2.95
LM320N-12	1.35	LM387N	1.35	LM3900N	.69
LM320N-3	.35	LM392N	.60	LM393CN	1.25
LM320T	.55	LM398H	4.00	LM3909N	1.15
LM320T-12	1.25	LM399H	5.00	LM3914N	1.95
LM320T-15	1.25	LM494CN	4.40	LM3915N	.95
LM320T-15	5.95	LT495CP	1.75	LM3915N	1.95
LM324N	.99	NE510A	6.00	RC4135N	1.25
LM329DZ	.65	NE529A	4.95	RC451NB	.95
LM331N	3.95	NE531H	3.95	RC4197K	5.95
LM334Z	1.00	NE540H	6.00	CD1947CT	5.40
LM335Z	.40	NE541B	6.00	K844C	4.25
LM336Z	1.75	NE544N	4.95	K844Z	5.95
LM337N	1.95	NE550A	1.30	LM4500A	3.25
LM337MP	1.95	NE555V	.39	LT4003B	4.95
LM338N	6.95	NE559N	.99	LM1380N	1.25
LM339N	.99	NE564N	.95	LM13600N	4.95
LM340K-15	1.35	LM565N	1.25	75138N	1.95
LM340K-12	1.35	LM565CN	1.95	75450N	.89
LM340K-12	1.35	LM565N	1.25	75450N	1.95

1250W-712 1.35 1.250W-713 1.250W-714 1.250W-715 1.250W-716 1.250W-717 1.250W-718 1.250W-719 1.250W-720

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## 50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.05	.05	.001μF	.08	.06	.05
47 pf	.08	.06	.05	.0047μF	.08	.06	.05
100 pf	.08	.06	.05	.01μF	.08	.06	.05
220 pf	.08	.06	.05	.022μF	.09	.07	.06
	.08	.06	.05	.047μF	.09	.07	.06
				.1μF	.15	.12	.10

## 100 VOLT MYLAR FILM CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.11	.10	.07	.1mf	.23	.17	.13
	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS							
1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
3.3/50V	.39	.34	.29	2.2/50V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.3/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

## MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Leads			
47/50V	.16	.14	.10	47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/50V	.20	.17	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
22/25V	.19	.16	.12	4.7/16V	.20	.17	.12
22/25V	.19	.16	.12	4.7/50V	.17	.15	.14
22/50V	.24	.20	.18	10/16V	.17	.15	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.35	.31	22/16V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.50	.44	.41	33/16V	.25	.21	.19
470/25V	.54	.49	.49	100/50V	.27	.24	.21
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27



### National Semiconductor Clock Modules

12VDC AUTOMOTIVE/INSTRUMENT CLOCK

APPLICATIONS:

- In-dash autoticks
- After-market auto/RV clocks
- Aircraft-marine clocks
- 12VDC oper. instr.
- Portable/battery powered instruments

Features: Bright 0.3" green display. Internal crystal time-base. ±0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

**MA1003 Module . . . . . \$16.95**

MA1023 .7" Low Cost Digital LED Clock Module . 8.95  
 MA1026 .7" Dig. LED Alarm Clock/Thermometer . 18.95  
 MA5036 .3" Low Cost Digital LED Clock/Timer . 6.95  
 MA1002 .5" LED Display Dig. Clock & Xformer . 9.95

### National Semiconductor RAM SALE

MM5290N-4 (MK4116/UPD416) . . \$4.95 each  
 16K DYNAMIC RAM (250NS)  
 (8 EACH \$39.95) (100 EACH \$450.00/lot)

MM5290J-2 (MK4116/UPD416) . . \$6.95 each  
 16K DYNAMIC RAM (150NS)  
 (8 EACH \$49.95) (100 EACH \$550.00/lot)

MM5298J-3A . . . . . \$3.25 each  
 8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS  
 (8 EACH \$23.95) (100 EACH \$250.00/lot)

MM2114-3 . . . . . \$5.95 each  
 4K STATIC RAM (150NS)  
 (8 EACH \$43.95) (100 EACH \$450.00/lot)

MM2114L-3 . . . . . \$6.25 each  
 4K STATIC RAM (LOW POWER 300NS)  
 (8 EACH \$44.95) (100 EACH \$475.00/lot)

### EPROM Erasing Lamp

UVS-11E . . . . . \$79.95

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact—only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

### Jumbo 6-Digit Clock Kit

JE747 . . . . . \$29.95

- Four .630" ht. and two .300" ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6 3/4" x 3-1/8" x 1 3/4"

### 6-Digit Clock Kit

JE701 . . . . . \$19.95

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6 3/4" x 3-1/8" x 1 3/4"

### JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:

- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2" w x 5-1/16" L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . \$24.95  
 (Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) . . \$14.95  
 JE205 Adapter Bld. (to JE200) ±5-9 & ±12V. \$12.95  
 JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. \$19.95

### MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES		DATA ACQUISITION (CONTINUED)	
INS8080A	CPU	6.50	ADC0809CCN
DP8212	8-Bit Input/Output	3.25	ADC0812CCN
DP8214	Priority Interrupt Control	5.95	DAC1208LCN
DP8216	8-Bit-Directional Bus Driver	3.49	DAC1209LCN
DP8224	Clock Generator/Driver	1.95	DAC1209LCN
DP8226	Bus Driver	1.49	DAC1209LCN
DP8228	System Controller/Bus Driver	4.95	DAC1209LCN
DP8238	System Controller	5.95	DAC1209LCN
INS8243	I/O Expander for 48 Series	5.95	AY-55013
INS8250	Asynchronous Comm. Element	16.95	
DP8251	Prog. Comm. I/O (USART)	7.95	
DP8253	Prog. Interval Timer	14.95	
DP8255	Prog. Peripheral I/O (PPI)	3.95	
DP8257	Prog. DMA Control	12.95	
DP8259	Prog. Interrupt Control	14.95	
DP8275	Prog. CRT Controller	49.95	
DP8279	Prog. Keyboard/Display Interface	4.95	
DP8300	Octal Bus Receiver	6.95	
DP8303	System Timing Element	6.95	
DP8304	8-Bit Bi-Directional Receiver	3.95	
DP8307	8-Bit Bi-Directional Receiver	3.95	
DP8308	8-Bit Bi-Directional Receiver	3.95	
6800/68000 SUPPORT DEVICES		PROMS/EPROMS	
MC68000	MPU	14.95	1702A
MC68010	MPU with Clock and RAM	18.95	2708
MC68011	128x8 Static RAM	4.95	2716
MC68012	Peripheral Interf. Adapt. (MC68010)	7.49	2732
MC68013	Priority Interrupt Controller	10.95	2764
MC68014	1024x8-Bit ROM (MC68013)	14.95	2716
MC68015	Asynchronous Comm. Adapter	6.95	2732
MC68016	Synchronous Serial Data Adapter	10.95	2764
MC68017	64000bps Digital MODEM	10.95	2716
MC68018	2400bps Modulator	12.95	2732
MC68019	Quad 3-State Bus Trans. (MC68018)	2.25	2764
MICROPROCESSOR CHIPS		ROMS	
Z80 (780)	CPU (MK3800N/4) (4MHZ)	13.95	2708
Z8001	CPU	15.95	2716
CDP1802	MPU	19.95	2732
2669	MPU	16.95	2764
10M2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95	2716
MC55602	MPU w/Clock (8K Bytes Memory)	11.95	2732
INS5030N-4	MPU—8-Bit (4MHZ)	16.95	2764
INS5030N-6	CPU—Sel. Chip 8-Bit (128 Bytes RAM)	18.95	2716
INS5040N-4	CPU (56 Bytes RAM)	24.95	2732
INS5040N-6	CPU (64 Bytes RAM)	24.95	2764
INS5073N	MPU w/Basic Micro Interpreter	29.95	2716
P806	CPU	19.95	2732
INS8900	CPU—16-Bit	29.95	2764
TMS5950JUL	MPU—16-Bit	49.95	2716
SHIFT REGISTERS		NIMOS READ ONLY MEMORIES	
MM5901H	Dual 25-Bit Dynamic	.50	MC68675P
MM5901H	Dual 100-Bit Static	.50	MC68676P
MM5901H	Dual 64-Bit Accumulator	.50	MC68677P
MM5901H	256-Bit Dynamic	3.95	
MM5901H	504/512-Bit Dynamic/Accumulator	1.95	
MM5901H	504/512-Bit Dynamic	.89	
MM5901H	Octal 80-Bit	5.95	
MM5901H	Octal 80-Bit	5.95	
MM5901H	1024-Bit Dynamic	3.95	
MM5901H	Hex 32-Bit Static	4.95	
MM5901H	512-Bit Dynamic	.99	
MM5901H	1024-Bit Dynamic	2.95	
MM5901H	Dual 256-Bit Static	2.95	
MM5901H	Dual 256-Bit Static	4.00	
MM5901H	Dual 240-Bit Static	2.95	
MM5901H	Quad 80-Bit Static	2.95	
MM5901H	Fifo (Data 80)	6.95	
DATA ACQUISITION		TELEPHONE/KEYBOARD CHIPS	
AF100-1CN	1000-Hz Filter	5.95	AY-5100
AF121-1CJ	Touch Tone Low Pass Filter	19.95	AY-5100
AF121-1CJ	Touch Tone Low Pass Filter	19.95	AY-5100
LM332	Constant Current Source	1.30	AY-5100
LM332	Temperature Transducer	1.30	AY-5100
LM332	JFET Input Op Amp	1.30	AY-5100
LM332	Sample & Hold Amplifiers	3.95	AY-5100
LM332	Temp. Comp. Prec. Ref. (50pm/C)	4.95	AY-5100
AD0809LCN	8-Bit A/D Converter (1.5LSB)	2.95	AY-5100
DAC0809LCN	8-Bit D/A Converter (0.25LSB)	2.95	AY-5100

### DESIGNERS' SERIES

#### Blank Desk-Top Electronic Enclosures

- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for serviceability and component accessibility.
- Top/bottom panels .080 thk. alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION: The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to 1/4" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.

Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	\$29.95
DTE-11	10.65"	\$32.95
DTE-14	14.00"	\$34.95

\$10.00 Min. Order—U.S. Funds Only  
 Calif. Residents Add 6% Sales Tax  
 Postage—Add 5% plus \$1 Insurance

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 1355 SHOREWAY ROAD, BELMONT, CA 94002  
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4/81

### JOYSTICKS

J5-5K

JVC-40

J5-5K 5K Linear Taper Pots . . . . . \$5.25  
 J5-10K 10K Linear Taper Pots . . . . . \$4.95  
 JVC-40 40K (2) Video Controller in case . . \$5.95

### AC and DC Wall Transformers

Part No. Input Output Price

AC 250 117V/60Hz 12 VAC 250mA \$3.95  
 AC 500 117V/60Hz 12 VAC 500mA \$4.95  
 AC1000 117V/60Hz 12 VAC 1 amp \$5.95  
 AC1100 117V/60Hz 9 VAC 1.7 amp \$6.95  
 DV 9200 117V/60Hz 9 VDC 200mA \$3.25  
 DC 900 120V/60Hz 9 VDC 500mA \$3.95

### CONNECTORS

DB25P D-Subminiature Plug . . . . . \$2.95  
 DB25S D-Subminiature Socket . . . . . \$3.50  
 DB51226 Cover for DB25P/S . . . . . \$1.75  
 22/44SE P.C. Edge (22/44 Pin) . . . . . \$2.95  
 UG88/U BNC Plug . . . . . \$1.79  
 UG89/U BNC Jack . . . . . \$3.79  
 UG175/U UHF Adapter . . . . . \$ .49  
 SO239 UHF Panel Recept. . . . . \$1.29  
 PL258 UHF Adapter . . . . . \$1.60  
 PL259 UHF Plug . . . . . \$1.60  
 UG260/U BNC Plug . . . . . \$1.79  
 UG1094/U BNC Bulkhead Recept. . . . . \$1.29

### TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.  
 Kit comes complete with:  
 \* 8 ea. MM5290 (UPD416/416) 16K Dyn. Rams (N'S)  
 \* Documentation for Conversion

TRS-16K2 \* 150NS . . . . . \$49.95  
 TRS-16K4 \* 250NS . . . . . \$39.95

### JE610 ASCII Encoded Keyboard Kit

JE610/DTE-AK (as pictured above) . . . \$124.95

JE610 Kit 62-Key Keyboard, PC Board, & Components (no case) . . . \$ 79.95

K62 62-Key Keyboard (Keyboard only) . . . \$ 34.95

DTE-AK (case only—3 1/2"H x 11 1/2"W x 8 1/2"D) \$ 49.95

### JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3 1/2"H x 8 1/4"W x 8 1/4"D

JE600/DTE-HK (as pictured above) . . . \$99.95

JE600 Kit 19-Key Hexadecimal Keyboard, PC Board & Cmpnts. (no case) . . . \$59.95

K19 19-Key Keyboard (Keyboard only) . . . \$14.95

DTE-HK (case only—3 1/2"H x 8 1/4"W x 8 1/4"D) \$44.95



# CompuPro computers don't JUST work: they WORK, and WORK, and WORK, and WORK, and

If there's anything more important than throughput, it's reliability: that's why **CompuPro** System Components are painstakingly engineered not just to work, but to keep on working. Say goodbye to unexplained system hardware glitches - **CompuPro** products conform to all IEEE 696/S-100 specifications, thereby ensuring well integrated (and predictable) system performance. Also, should a system malfunction ever occur, the bus oriented nature of S-100 machines allows you to simply pull out the bad board and plug in a replacement. . . and when you depend on a computer, you know what it means to minimize down time.

All **CompuPro** products meet the most demanding mechanical and electrical standards, and are backed with one of the best warranties in the business (1 year limited warranty on all products, 2 year limited warranty with exchange program for products qualified under the **Certified System Component** program).

Sure, computers can be great intelligent toys; but for scientific, industrial, and commercial applications, toys aren't good enough. You need a computer that works, works right, and keeps on working: you need **CompuPro** system components.

## NEW! DISK 1: THE ULTIMATE A/T \$495, CSC \$595 DISK CONTROLLER.

Finally, a disk controller worthy of the **CompuPro** name. This state of the art design uses properly implemented DMA with **arbitration**, meaning that **Disk 1** can co-exist - without any conflict whatsoever - on the same bus as other DMA devices. And because **Disk 1** has 24 bit DMA addressing (not memory mapped), you have access to a full 16 megabyte memory map.

What about speed? **Disk 1** transfers data independently of CPU speed, allowing operation with 6 MHz Z80s\*. Versatility? **Disk 1** handles up to four 8" or 5.25" floppy disk drives (including 96 track high density minifloppies), single or double sided, single or double density (soft sector). Convenience? **Disk 1** includes BIOS for CP/M-80\*, as well as on-board boot for automatic startup and on-board serial port for system initialization startup. Compatibility? **Disk 1** is compatible with MP/M\*, OASIS, CP/M-80, and CP/M-86. Reliability? Uses industry-standard, third generation controller chips and the same design excellence that is a part of every **CompuPro** product.

We weren't going to put out another me-too disk controller... and we didn't. The **CompuPro Disk Controller** is here.

## SYSTEM SUPPORT 1 MULTIFUNCTION BOARD

\$295 Unkit, \$395 A/T, \$495 CSC

This multi-purpose S-100 board provides sockets for 4K of extended address EPROM or RAM (2716 pinout) with one battery backup socket; battery backup month/day/year/time crystal clock with BCD outputs; optional math processor (9511 or 9512); full RS-232 serial port; three 16 bit interval timers (cascade or use independently); two interrupt controllers service 15 levels of interrupts; power fail indicator; and comprehensive owner's manual with numerous software examples. Conforms fully to all IEEE 696/S-100 standards. (Add \$195 to the above prices for the optional 9512 math processor.)

## SOFTWARE

**8088/8086 MONITOR-DEBUGGER:** Supplied on single sided, single density soft-sector 8" disk. CP/M\* compatible. Great development tool; mnemonics used in debug conform as closely as possible to current CP/M\* DDT mnemonics. **\$35.**

**PASCAL/M\* FROM SORCIM:** PASCAL - easy to learn, easy to apply - can give a microcomputer with CP/M\* more power than many minis. We supply a totally standard **Wirth PASCAL/M\* 8" diskette** and comprehensive manual. Specify Z-80\* or 8080/8085 version. **\$175.**

Most **CompuPro** products are available in **Unkit** form. Assembled/Tested, or qualified under the high-reliability **Certified System Component (CSC)** program (200 hour burn-in, more). Note: **Unkits** are not intended for novices, as de-bugging may be required due to problems such as IC infant mortality. Factory service is available for **Unkits** at a flat service charge.

## COMPUTER ENCLOSURE 2

Introductory price: \$795 (specify rack mount or desk top version)

Includes fused, constant voltage power supply (+8V at 25 Amps,  $\pm 16V$  at up to 6 Amps); 20 slot shielded/active terminated motherboard; and deluxe enclosure with dual AC outlets on rear, heavy-duty line filter, circuit breaker, quiet ventilation fan, and reset switch. Rack mount version includes slides for easy pull-out from rack frame.

Also available: **COMPUTER ENCLOSURE 1.** Same as above, but less power supply and motherboard. **\$289** desktop, **\$329** rack mount.

## PRICE BREAKTHROUGH ON 16K MEMORY EXPANSION - 8 RAMS/\$29

These top quality, low power, high speed (200 ns) 16K dynamic RAMs expand memory in TRS-80\* -I, -II, and -III computers (color model too) as well as machines made by Apple, Exidy, Heath H89, newer PETs, etc. Backed by 1 year limited warranty. Add \$3 for two dip shunts plus TRS-80\* conversion instructions. Limited quantity.

## S-100 MEMORIES FROM THE MEMORY LEADER

**CompuPro** memories feature fully static design to eliminate dynamic timing problems, full conformance to all IEEE 696/S-100 specifications, high speed operation (4/5 MHz Unkit, 10 MHz A/T and CSC), low power consumption, extensive bypassing, and careful thermal design.

	Unkit	A/T	CSC
8K RAM 2A.....	\$159	\$189	\$239
16K RAM 14 (extended addressing).....	\$279	\$349	\$429
16K RAM 20-16 (extended addressing and bank select).....	\$319	\$399	\$479
24K RAM 20-24 (extended addressing and bank select).....	\$429	\$539	\$629
32K RAM 20-32 (extended addressing and bank select).....	\$559	\$699	\$799

**NEW! 64K STATIC RAM 17.** Amazingly low power in a 64K fully static RAM board: less than 500 mA maximum, 250 mA typical! It's fast, too; runs with 6 MHz Z-80\* CPUs, or 10 MHz 8080-family CPUs (8085, 8088, etc.). Uses IEEE extended addressing protocol, and may optionally turn off 2K windows from E000 to FFFF in order to accommodate North Star or Morrow disk controllers (the **CompuPro** disk controller can use the full 64K since it employs properly implemented DMA techniques). **\$1095** Unkit, **\$1395** A/T, **\$1595** CSC.

**TERMS:** Prices shown do not include dealer installation and support services. Cal res add tax. Allow at least 5% shipping; excess refunded. Orders under \$15 add \$2 handling. VISA® and Mastercard® orders (\$25 min) call our 24 hour order desk at (415) 562-0636. Include street address for UPS delivery. Prices are subject to change without notice.

**FREE CATALOG:** Want more information? Then send for our free catalog. For fast 1st class delivery, add 41 cents in stamps; foreign orders add \$2 (refundable with order).

\*LEGAL CORNER: Z80A is a registered trademark of Zilog; TRS-80 is a trademark of the Tandy Corporation; PASCAL/M is a trademark of Sorcim; CP/M and MP/M are registered trademarks of Digital Research.

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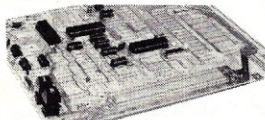


Start learning and computing for only **\$129.95** with a **Netronics 8085-based computer kit**. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.

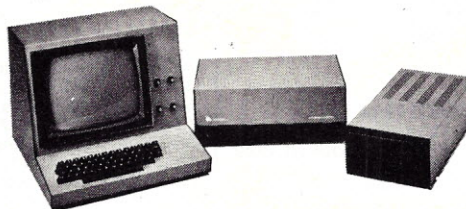
# THE NEW EXPLORER/85 SYSTEM

**Special! Full 8" floppy, 64k system for less than the price of a mini! Only \$1499.95!**  
(Also available wired & tested, \$1799.95)

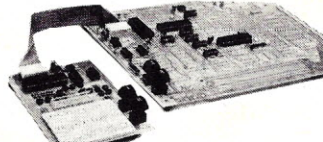
Imagine — for only \$129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers on-board S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only \$129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.



Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. \$129.95



Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)



Level "A" With Hex Keypad/Display.

## LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O... all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

**PC Board:** Glass epoxy, plated through holes with solder mask. • I/O: Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader... cassette tape recorder input and output... cassette tape control output... LED output indicator on SOD (serial output) line... printer interface (less drivers)... total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt... additional provisions for RST 5.5, 6.5 and TRAP interrupts on-board. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems... RAM expandable to 64K via S-100 bus or 4k on motherboard.

**System Monitor (Terminal Version):** 2k bytes of deluxe system monitor ROM located at F700, leaving 6000 free for user RAM/ROM. Features include tape load with labeling... examine/change contents of memory... insert data... warm start... examine and change all registers... single step with register display at each break point, a debugging/training feature... go to execution address... move blocks of memory from one location to another... fill blocks of memory with a constant... display blocks of memory... automatic baud rate selection to 9600 baud... variable display line length control (1-255 characters/line)... channelized I/O monitor routine with 8-bit parallel output for high-speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

**System Monitor (Hex Keypad/Display Version):** Tape load with labeling... tape dump with labeling... examine/change contents of memory... insert data... warm start... examine and change all registers...

single step with register display at each break point... go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

## HEX KEYPAD/DISPLAY SPECIFICATIONS

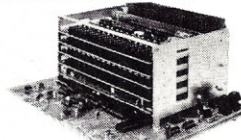
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

## LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for on-board 4k RAM expansion selectable in 4k blocks... address decoding for on-board 8k EPROM expansion selectable in 8k blocks... address and data bus drivers for on-board expansion... wait state generator (jumper selectable), to allow the use of slower memories... two separate 5 volt regulators.

## LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



Explorer/85 With Level "C" Card Cage.

## LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the origi-

nal 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

## LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of on-board RAM).

## DISK DRIVE SPECIFICATIONS

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- LSI controller.
- Write protect.
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- Access time: 25ms (one track).

## DISK CONTROLLER / I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports.
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

## DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

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**Beginner's Pak (Save \$26.00!)** — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price \$199.95), now at SPECIAL PRICE: \$169.95 plus post. & insur.

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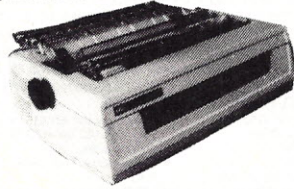
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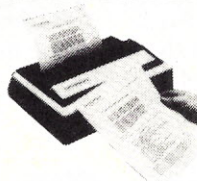
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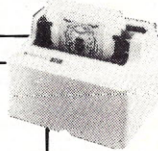
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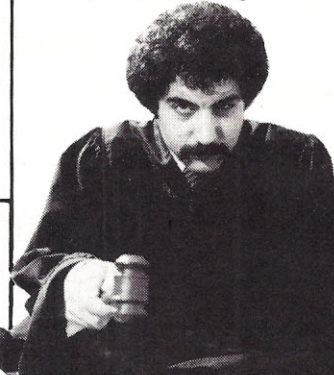
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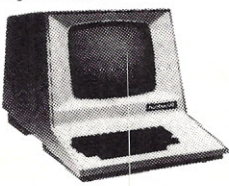
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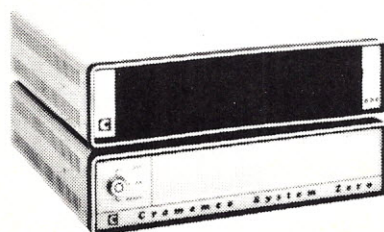
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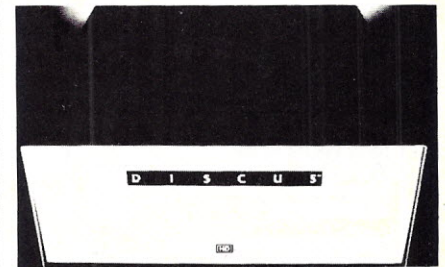
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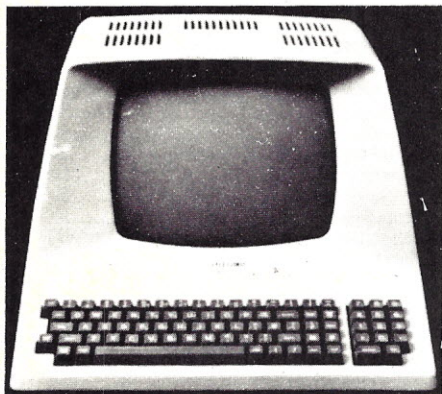


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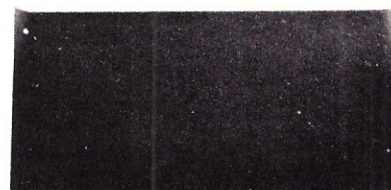
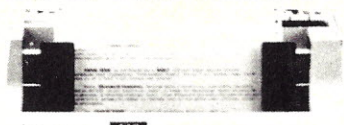
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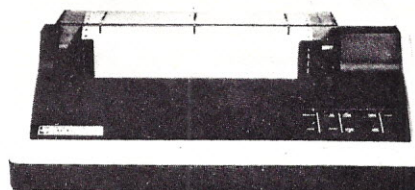
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# LETTERS

(from page 29)

with dummy data to obtain the proper entry. In either case, this would mean lost memory, speed and efficiency.

This principle of indexing into tables is an important and extensively used application in assembly-language programming. In a higher-level language, this would be similar to an array. The efficiency of indexing using zero numbering is the same whether there are 77, 128 or even two elements in a table.

Secondly, examine any assembly language and see how many instructions refer to zero. Each of these instructions calls for the processor to do some function (jump, return, call, etc.) if equal to 0, not equal to 0, greater than 0, less than 0. Here, zero numbering comes into play again. If our program was to read all 77 tracks on a disk, it is very easy to exit the read loop after it has read track 0 by using one of these conditional instructions. There are ways around this, but usually at a loss of speed, efficiency and usually not conforming to structured programming.

Thirdly, Mr. Piescik's point is a valid one. With zero numbering, memory is conserved, since more items can be described with the same number of bits. Even though the memory saving may be small by itself, throughout an entire system, it can become a significant factor.

To illustrate how all three points can fit together, suppose our system can transfer a character from any one of 32 CRTs to any one of 32 printers (assume a four-bit processor). Already the illustrious salespeople can sell one additional CRT and one additional printer with the same software (point #3). Our program starts with the last CRT (#31) and can quickly index into a table for the appropriate routing and processing (point #1). After CRT #0 is done, a simple zero conditional instruction takes us out of the program (point #2).

While it is confusing to refer to the first item as item #0 and may not be necessary when using higher-level languages, it is definitely *not* something that someone invented just to confuse novices. Zero numbering is as much a part of programming as the binary system.

**William McGarry**  
Stratford, CT

## In the Switch of Time

The construction article in the July issue ("A Hexadecimal Front Panel for Z-80 Systems," John D. Ciana, p. 148) could not have come at a better time. I had been planning a homebrew Z-80 system for some time, and I was working on

a front panel design. The cost of my design would run about \$120, would have less capability than John Ciana's configuration and would require a giant leap backward to the prehistoric Altair-style toggle switch approach. By contrast, Ciana's circuit would cost less and provide hardware single-step and breakpoint.

The circuit seemed satisfactory for the most part, but instead of buying ten of those expensive hex decoder chips, I decided to multiplex the ten display digits. As a result I saved money, not only on decoders, but also on power consumption (I need one less 5-volt regulator). The multiplex circuit is shown in Fig. 1.

**Bruce Malmat**  
Silver Spring, MD

## False Advertising

I am usually very unhappy concerning false advertising, such as appears in your ad on p. 230 of the December 1980 issue. I refer to the Library Shelf Boxes which

are advertised to "... hold a full year of *Kilobaud Microcomputing*."

I have news for you. The year should have ended after the October issue.

Keep up the good work. I'd love to fill one up in six months!

**John W. Warne**  
Gainesville, FL

## Wari Is a Winner

I have just loaded the Wari game by L. D. and P. H. Stander, published in *Kilobaud Microcomputing*, November 1979, p. 118. It was very easy to adapt to Microsoft BASIC and run it on my Sorcerer computer.

The reason I am writing is to thank you for publishing it. It is one of the more enjoyable games I have seen because it is somewhat challenging if played against a computer or a human opponent, and it runs fast and loads in less than 4K of BASIC.

**Jacob L. Zar**  
No. Andover, MA

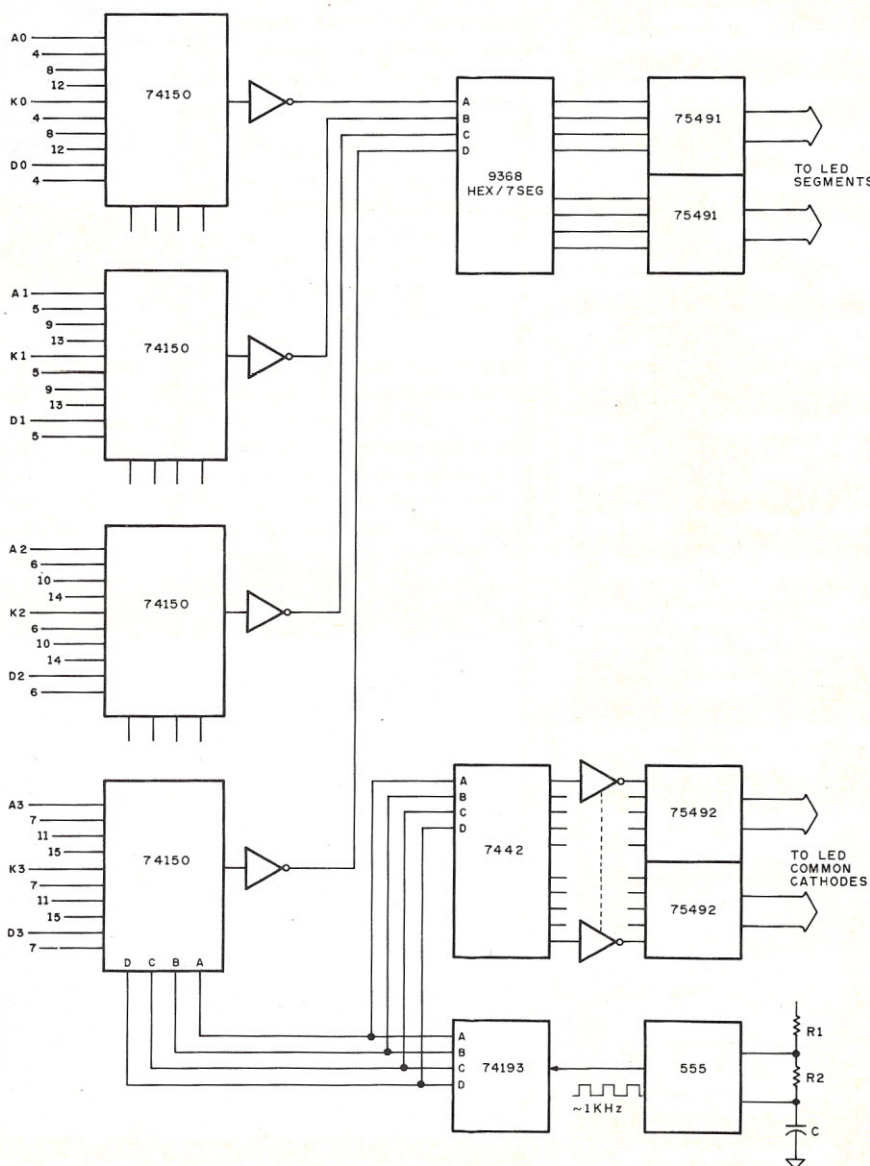


Fig. 1.



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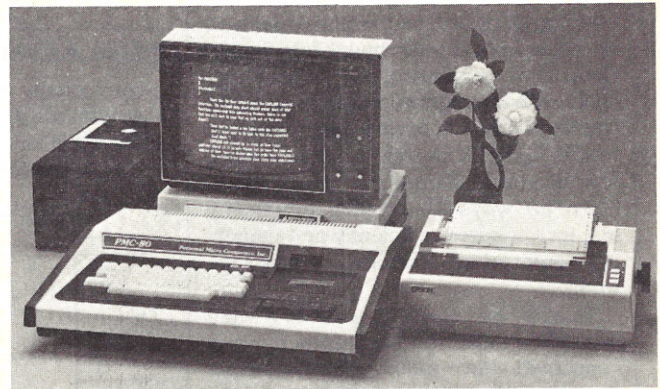
# NEW PRODUCTS

Edited by Dennis Brisson

## Model III Mini-Disk Storage System PMC-80 Expander IEEE 488 Acoustic Modem Apple Laboratory Interface Card

### Four Mini-Disk Drives for TRS-80 Model III

TRS-80 Model III owners can now add up to four drives to their computers, and thus increase on-line formatted storage capacity to almost 1.5 megabytes, with mini-disk (5-1/4 inch) storage systems from Percom Data Company, 211 N. Kirby, Garland, TX 75042. Systems come with either 40- or 80-track drives that are rated for both double- and single-density operation. Both drive models are capable of "floppy" operation, so that diskette storage can be twice the on-line capacity. The first two drives mount inside the Model III; the third and fourth drives mount external to the computer. The initial internal drive system sells for \$749.95 (40-track) and \$914.95 (80-track). Reader Service number 474.



The PMC-80 and peripherals.

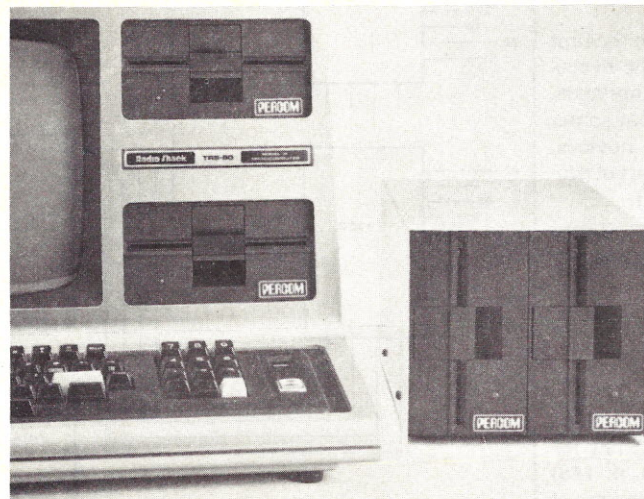
### Disk-Based System For PMC-80

The model EXP-100 expander for the PMC-80 provides 32K memory expansion, minifloppy disk interface for four drives, Centronics parallel printer interface, RS-232C interface and an S-100 bus to provide addition-

al interface capabilities. With the Expander, the PMC-80 is capable of a number of configurations ranging from a simple, low-cost Level II tape-based system to a fully implemented word processing or business system utilizing the same software as was developed for the TRS-80 Model I computers. It will run TRSDOS software as well as other operating systems designed for TRS-80 compatibility such as NEWDOS and VTOS. Prices are \$410 without memory and \$245 for 16K or \$295 for 32K memory board.

The model PIF-40 plug-in printer interface permits any printer with a Centronics-compatible interface to be connected to the PMC-80 without the need for the Expander. Price is \$95.

Personal Micro Computers, Inc., 475 Ellis St., Mountain View, CA 94043. Reader Service number 472.



Percom's mini-disk drives for the Model III.

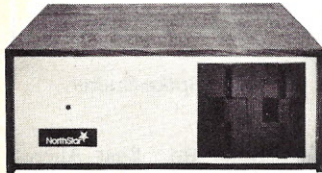
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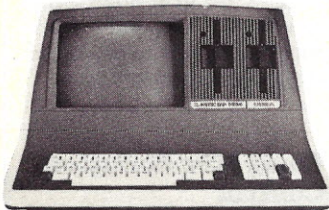
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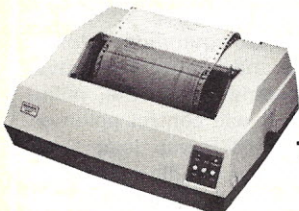
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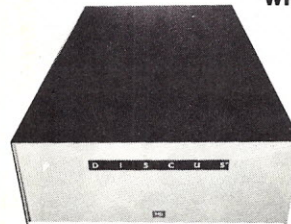
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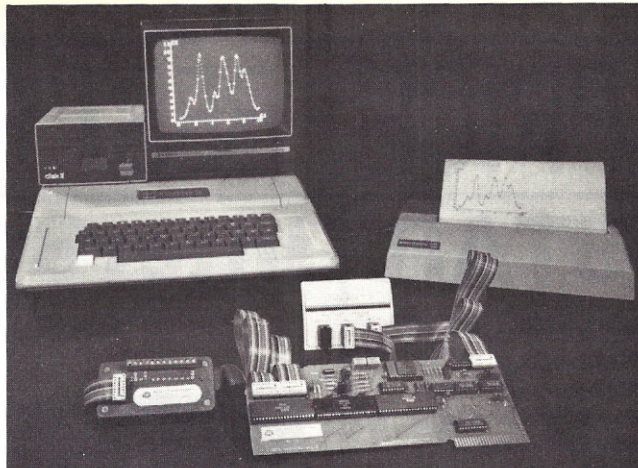




Livermore's Star modem.

in a series of 300 bps acoustic modems from Livermore Data Systems, Inc., 2050 Research Drive, Livermore, CA 94550. It includes the direct IEEE 488 interface necessary for use with Hewlett-Packard, Tektronix and Commodore PET computers.

The Star 488 features crystal-controlled frequency generation, a convenient self-test mode and exclusive triple-seal cups that lock the handset into acoustic isolation and adapt to most handsets used throughout the world. This



Interactive Microware's APPLAB for the Apple II+.

10.75 x 4.5 x 2-inch unit weighs two pounds and is compatible with all 103-type modems. Reader Service number 471.

### Laboratory Computer System

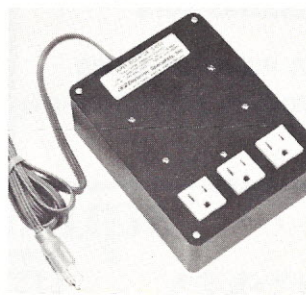
The APPLAB interface card, designed for the Apple II+ computer, can be used to con-

trol or collect data from most scientific instruments, such as spectrophotometers, chromatography systems, pH meters, strip chart recorders and temperature controllers. It features 12-bit D/A and A/D converters with jumper-selectable ranges of  $\pm 0.5$  V,  $\pm 1.0$  V,  $\pm 2.0$  V and  $\pm 4.0$  V. The digital subsystem features eight bits each of input and output, versatile handshaking signals, interrupt circuitry and TTL-compatible signal levels. A 32-bit real-time clock displays time in hours, minutes and seconds and permits timing of events to an accuracy of 0.1 second. Two 16-bit timers may be configured as an interval timer, pulse counter, pulse generator, square wave frequency generator or shift register. Price is \$495.

Interactive Microware, Inc., PO Box 711, State College, PA 16801. Reader Service number 482.

### Surge Suppressors

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The Super Isolator from Electronic Specialists.



Kalglo's Spike-Spiker.

6584 Ruch Rd., East Allen Township, Bethlehem, PA 18017, has added two new models to its Spike-Spiker series:

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The Spike-Spiker Mini II, in addition to protecting against power-line transients, also provides rf "hash" filtering of conducted interference between the computer or sensitive instruments from motorized or "noisy" equipment in the vicinity of the computer. These 3 x 4 x 1-1/2 inch units weigh less than 1/2 lb. and are prewired and ready to use. Reader Service number 476.

### Computer Pollution Control

Stamp out electrical pollution, which can often cause erratic computer operation or even expensive hardware damage, with the Super Isolator from Electronic Specialists, Inc., 171 South Main St., Natick, MA 01760. Incorporating heavy-duty spike/surge suppression, the Super Isolator features three individually dual-Pi filtered ac sockets to eliminate equipment interactions and control disruptive, damaging power line pollution. It will control pollution for an 1875 watt load. Each socket can handle a 1000 watt load. Price is \$94.95. Reader Service number 470.

### Insertion and Extraction Tools

OK Machine and Tool Corporation, 3455 Conner St.,

BLITZ BUG LIGHTNING & TRANSIENT VOLTAGE SUPPRESSOR

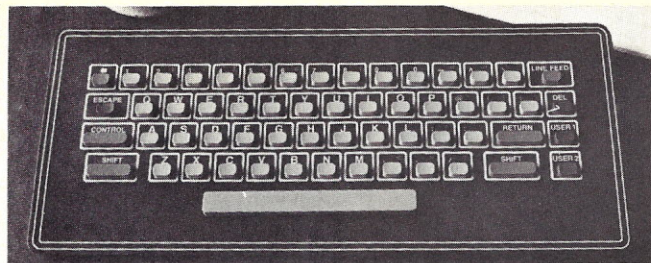
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AID's microprofile keyboard design.

Bronx, NY 10475, has introduced its new MDD series of DIP IC dispensers for MOS and CMOS, as well as standard devices. Each channel accepts any standard IC shipping tube, and can accommodate any standard IC from 2-42 pins on .300, .400 or .600 centers. Adjustable guides position each IC individually for easy extraction, and simple gravity feed assures reliable deposit of the next IC into extraction position after the previous IC is removed. Available in 1-, 5- and 10-channel versions for \$21.85, \$83.43 and \$160.45, respectively. Reader Service number 473.

## 25 Watt Plug-In Power Supply

Now a wall plug-in power supply that delivers up to 25 watts of regulated dc power is available from Ault, Inc., 1600H Freeway Blvd., Minneapolis, MN 55430. Two versions are offered for microprocessor-based systems: single output (+5 V at 5 amperes) and triple output (+5 V at 2.5 amperes and  $\pm 12$  V at .2 amperes). There is also a single-output unit (48 V at .5 amperes) for telephone applications. These new power supplies can be plugged into any conventional wall outlet. Reader Service number 477.

## New Keyboard Design

The MK 058 is a 58-key sealed keyboard with a micro-profile button construction (0.4 inch), which allows improved packaging capabilities for portable and desk-top applications. It provides a crisp, tactile feedback to the operator, and features custom legend sheets and keytop colors.

Legends are placed on the bezel to provide a more advanced styling or can be added to the buttons to allow more than one operating mode for the keyboard.

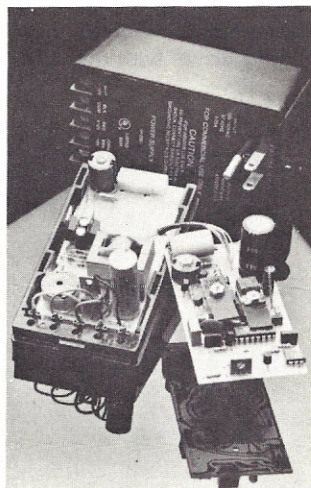
Advanced Input Devices, PO Box 1818, Coeur d'Alene, ID 83814. Reader Service number 483.

## Letter-Quality Printer

The Sellum I is an intelligent, letter-quality printer that features automatic bidirectional printing, switch/software-selectable baud rate and logic-seeking capabilities that allow a maximum of 700 words per minute. The 650-character buffer and optional 16K buffer for printer spooling allow simultaneous data entry and printing. An optional front panel and Diablo-compatible software are available.

The Sellum I is compatible with any computer utilizing RS-232-C serial, Centronics-type or 20 uA current-loop interfaces, and will support both keyboard and additional firmware. Price is \$3495.

Intersell, 465 Fairchild



Ault's plug-in power supply.

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Magic Wand (Super Word Processor!!)	\$345
Pearl Level III (best prog. tool available)	\$645
CBASIC-2	\$110
TRS-80 <sup>®</sup> MOD II CP/M <sup>®</sup> 2.2 (P & T)	\$185
H89/Z89 CP/M <sup>®</sup> 2.2 (Magnolia)	\$199

Formats: Std. 8", 5" NorthStar DD, TRS-80 MOD II<sup>®</sup> H89/Z89. Manuals for GL, AR/AP, and PR are not included in price - add \$20 per manual desired (AR/AP are in one manual). CP/M<sup>®</sup> and CBASIC-2 required to run accounting software. Users must sign licensing agreement. Dealer inquiries invited.

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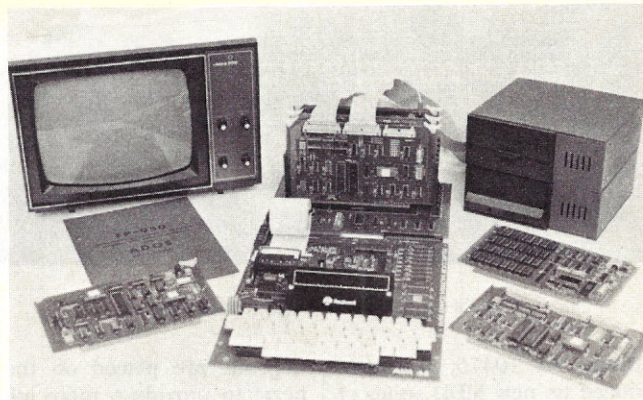
Mimic's plug-in speech processor for the TRS-80.

Drive, #214, Mountain View, CA 94043. Reader Service number 480.

### Digital Speech Processor

The Mimic Speech Processor converts speech signals to

a digital bit stream for computer storage or automatic speech recognition purposes. It also reconstructs the digital speech representations to analog form for reproduction through an available speaker. Since both the speech encoder (input) and decoder (output) functions are located in a



The DSAIM-65 from Applied Business Computer.

single unit, the system can also be used for speech communications applications without a computer. Speech data rate is user selectable. Several versions are available: a bare board for user assembly (under \$20), a fully assembled and tested module (\$79), a general-purpose plug-in system which connects directly to a parallel I/O port on most computers (\$149) and a complete TRS-80-compatible plug-in version (\$169).

Mimic Electronics Co., PO Box 921, Acton, MA 01720. Reader Service number 481.

of mass storage on-line expandable to over 1.1 megabytes, six-card-slot expansion board and a Centronics-type printer interface. Software includes the ADOS disk operating system, BASIC high-level language, assembler, editor and debug monitor. Reader Service number 475.

### S-100 Multifunction Board

System Support 1, a multifunction board for S-100 microcomputers, provides sockets for 4K of EPROM or RAM, as well as a socket for an optional math processor, two interrupt controllers, real-time calendar/clock, three 16-bit interval timers and a full RS-232 serial channel with software-selectable baud rate. If micropower RAM is used in one of the memory sockets, it can also run from the same battery used to back up the clock in the event of power failure. Price is \$395, assembled and tested.

CompuPro, Building 725, Oakland Airport, CA 94614. Reader Service number 478.

### AIM-65 Development System

Applied Business Computer Co., 707 S. State College Blvd., Suite G, Fullerton, CA 92631, has recently announced the AIM-65 Development System. Designated the DSAIM-65, this development system for the 6500 microprocessor family features an 80-character x 25-line display, 32K expandable to 64K RAM, dual single-sided double-density mini-floppy drives with over 280K



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Industrial quality data conversion boards (A/D and D/A) are available for **APPLE, S-100, PET, TRS-80, AIM,** and **KIM** systems. Tecmar's new analog to digital converter series provides some of the most sophisticated and versatile analog data acquisition available for any computer. It supports options such as 12, 14, or 16 bit accuracy; 30, 40, 100, or 125 KHz conversion rates; variable ranges and gains;  $\pm 250V$  of common mode voltage

range; multiplexer expansion up to 256 channels; thermocouple cold junction compensation. In addition, the S-100 board contains a powerful timer/counter circuit which can start A/D conversion and can also be used independently for time of day, event counting, frequency shift keying and many other applications.

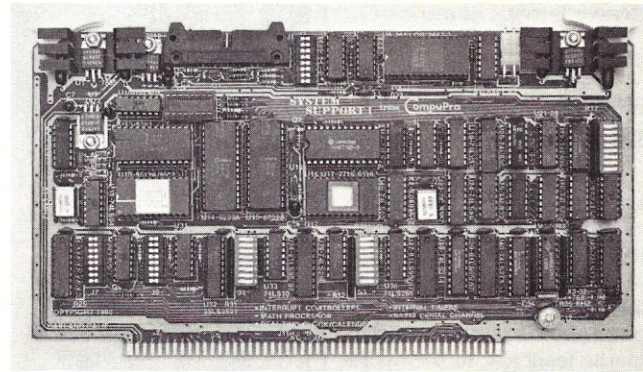
Apple A/D Board	16 channel 12 bit	\$495
Apple D/A and Parallel Output Board	2 channel 12 bit	\$295
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S-100 D/A Board	4 channel 12 bit	\$395

Call for complete product line information.



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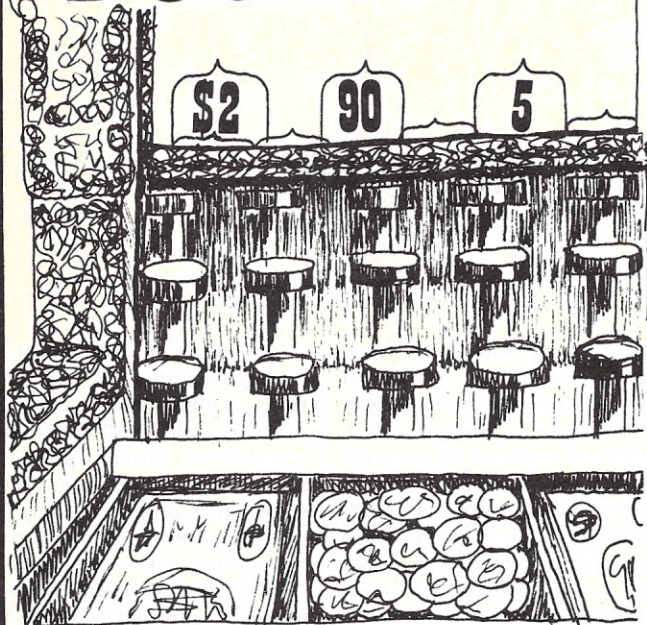
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CompuPro's System Support 1.



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# Software for the TRS-80 Color Computer PET Educational Programs CP/M-Based Editor Heath Inventory Management System

## CP/M-Based Editor

CP/M-based text processing is easy to learn with Mince, a full-screen editor that uses a mnemonic control-character command set, allowing all textual characters to be entered directly into the document without confusing input and edit modes. With over 80 commands, Mince can edit more than one document to another and display two documents on the screen at once. It features automatic paragraph fill and commands which deal with words, sentences, paragraphs and user-defined text regions, as well as lines and characters. Price is \$125.

Mark of the Unicorn, PO Box 423, Arlington, MA 02174. Reader Service number 468.

## CP/M-DEC Reformatter

Now your Z-80- or 8080-based microcomputer can exchange data files with DEC

computers using the floppy disk as the transfer medium. The Reformatter diskette conversion program runs under the CP/M operating system and reads and writes floppy disks in the DEC RT-11 format. You can transfer data files bidirectionally and alter any of the fields in the DEC RT-11 directory. Reformatter also lists the DEC directory and displays the unused area of the disk. A squeeze function, which allows a "fragmented" DEC diskette to be packed into a continuous data area, is available. Price is \$195.

MicroTech Exports, 467 Hamilton Ave., Palo Alto, CA 94301. Reader Service number 491.

## CP/M for North Star

North Star CP/M 2.2 is a fully compatible version of CP/M for both floppy and hard disk systems for Horizon system users. This monitor control program for microcomputer

system development uses both North Star 5-1/4-inch floppy and 14-inch hard disks for storage. It provides a general environment for program construction, storage and editing, along with assembly and program checkout facilities. This new release consists of a single diskette which works with double density, quad capacity and hard disk systems, and features a unique sequential file access capability.

North Star Computers, Inc., 1440 Fourth St., Berkeley, CA 94710. Reader Service number 488.

## Newtalk

The machine-language programmer now has a convenient way of checking memory contents against a printed program listing with the Newtalk program for 6800 and 6809 systems. It is a completely relocatable utility which does a byte-by-byte memory dump of a selected memory area, and prints the output on the screen as well as reading it out through a loudspeaker. A speaker/amp, signal tracer or telephone amplifier is required to amplify and convert the computer output to sound. Price for disk or cassette is \$35.

Star-Kits, PO Box 209, Mt. Kisco, NY 10549. Reader Service number 484.

## Heath/Zenith Business Software

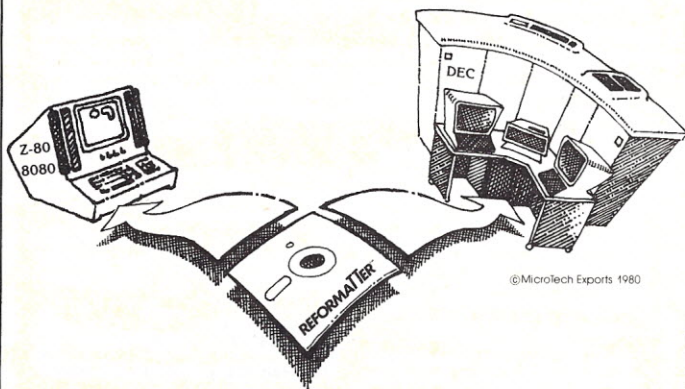
The Inventory Management system lists over 1100 items,

which you can add, delete, change and display, and 17 fields of information for each item for use in small-business operations. Direct on-line sales/returns and orders/receipts entry provide automatic on-hand and sales history adjustment. Status, sales history, reorder, physical reconciliation and user-selectable summarization reports are available. It requires the Heath/Zenith H8/H19 or H-89 with HDOS operating system, Microsoft BASIC, 48K RAM, two 5-1/4-inch disk drives and a 132-column line printer. Price is \$199.95.

XtraSoft, Inc., PO Box 91063, Louisville, KY 40291. Reader Service number 467.

## Apple Apartment Management

The Landlord provides property owners and managers with listings of apartments, residents and past residents, as well as reports on vacancies, lease expirations, intents to vacate and resident payments. It can handle apartment properties of up to 400 units. Records of disbursements and other financial transactions are maintained by the system, and a monthly property analysis statement is produced. Resident charges and payments, as well as security and pet deposits, returned checks and overpayments are handled by the system. A balance report allows expedient followup of delinquent residents. It requires an Apple II with 48K RAM, two disk drives and either a Silentype or Centronics 779 printer. Price is \$795.



MicroTech Exports' Reformatter allows data exchange between Z-80 or 8080-based micros and DEC equipment.



MIN Microcomputer Software, Inc., 5835-A Peachtree Corners East, Norcross, GA 30092. Reader Service number 490.

### Chinese Lessons From Apple

Do you have a yen to learn the Chinese language? In 11 easy-to-use lessons you can master Chinese greetings, times, seasons, numbers, foods and other commonly used terms (200 in all). Color, graphics and sound are used in each lesson, and memory aids, meanings and pronunciations are presented with the Chinese characters. The program features drill and practice under user control and exercises with exam scoring. Chinese Lessons is available for the Apple II 48K in AppleSoft with a single disk drive on a reversible 5-1/4-inch diskette. Price is \$29.95, plus \$1.50 shipping and handling.

Computer Translation, Inc., Department EMG, Box 7004 University Station, Provo, UT 84602. Reader Service number 463.

### Atari Exercise Program

Health-conscious computer owners can now stay in shape with the Atari Personal Fitness program. A series of questions and answers provides information the computer uses to formulate a customized exercise program. The computer then displays an exercise figure and counts out the routine. At the end of each session, progress is recorded and charted, then revised to meet physical fitness goals. The program is on cassette tape, requiring a minimum of 16K RAM and an Atari 410 Program Recorder.

Atari Consumer Division, 1265 Borregas Ave., PO Box 427, Sunnyvale, CA 94086. Reader Service number 489.

### 6502 Assembler Package

HESBAL is a full-featured 6502 assembler for your PET/CBM. It leaves over 1200 bytes free (8K PET) for your

use and requires one tape or disk drive. Features include label size of six characters or more, several pseudo-opcodes and over 25 error messages.

HESEDIT is a full-screen editor which can be used to prepare source for HESBAL, or can be used by itself for maintaining data files. Features include repeating keys; editing 22 lines at a time; inserting, deleting and duplicating lines; and scrolling forwards and backwards by any amount. Loads on old or new ROMs. Prices are \$23.95 for cassette and \$26.95 for diskette.

Human Engineered Software, 3748 Inglewood Blvd., Room 11, Los Angeles, CA 90066. Reader Service number 492.

### Color Computer Software

The following new utility software has been introduced for the TRS-80 Color Computer:

—Renumber provides the ability to load a program, renumber it and then save it.

—Squeeze will compress BASIC code to utilize minimum memory.

—Merge allows two separate programs on cassette to be concatenated in memory and then saved. Cassette price is \$19.95.

Mint Software, 6422 Peggy St., Baton Rouge, LA 70808. Reader Service number 494.

—The CBUG Monitor tape features 19 commands and allows you to

—examine or change memory using a formatted hex display

—save areas of memory to cassette in binary

—download/upload data or programs to a host system

—move the video display page throughout RAM

—send or receive RS-232 at up to 9600 baud

—use your Color Computer as an intelligent peripheral for another computer, a color display or a 6809 program development tool. Price is \$29.95. A disassembler that runs on the Color Computer and allows you to generate your own source listing of the BASIC interpreter ROM is also

available for \$49.95.

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The Micro Works, PO Box 1110 Del Mar, CA 92014. Reader Service number 495.

## PET Educational Software

The following educational software for the PET computer has recently been released by Teaching Tools, Microcomputer Services, PO Box 12679, Research Triangle Park, NC 27709:

—Addition and Subtraction programs suitable for grades one through six and for special education classes. Immediate feedback is given, with graphics reinforcing correct responses. You can set the number and level of difficulty of the problems, the time limit and the number of attempts allowed on each problem.

—Letters and Numbers program for young children first learning to use the computer. Using large letters and numbers, it tests for matching of one or more items, completing sequences and filling in missing items.



Standard & Poor's system for the TRS-80.

—Match Game program useful for memory building and for putting lesson reviews into a game format. One to four players can participate in matching shapes and synonyms and answering math problems, or single players can play against the computer.

Each program, which costs \$20, requires at least 8K and

1.0, 2.0 or 4.0 ROM. Reader Service number 485.

## Stock Analysis Program

Now you can duplicate the professional investment strategies used in the financial community with Stockpak, a complete stock analysis and portfolio management package. Standard & Poor's system provides for evaluating and managing a stock portfolio of up to 100 securities with as many as 30 transactions on each issue. You can also analyze 900 New York and American exchange and over-the-counter common stocks and generate reports to guide investment decisions. In addition, you can record buy and sell transactions, price and dividend information and stock splits and instantly retrieve this information for record keeping and tax purposes. It is designed for use with the Model I or III TRS-80 32K business computer system. Price is \$49.95.

Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102. Reader Service number 498.

## Mailing List Data Base System

Now you can organize your mailing lists, personal address book functions or mail lists based on dates with Mail-list for the TRS-80 Models I, II and III. It uses an ISAM-based

file system to minimize disk access times. A data base consists of a master file and up to four index files, which allows the primary file to be maintained in sorted order by name, zip code and up to two dates. Maillist allows you to specify up to 30 attributes, which are used in record selection when generating reports or mailing labels. It supports nine-digit zip codes and three-digit state codes. Prices are \$75 for the Models I and III and \$150 for the Model II.

Racet Computes, 1330 N. Glassell, Suite M, Orange, CA 92667. Reader Service number 486.

## Audiophile Library System

Audiophile Library System (ALS) is for the serious music lover who wants to inventory his large collection of records, tapes or cassettes on disk. Each selection added to the file is stored by record number, tape number, title, composer, artist(s), conductor, orchestra and source. A specific selection or all selections with a common attribute can be instantly retrieved and displayed on the screen; it is not necessary to use the complete nomenclature of the item to be found. Designed for the TRS-80 Models I and III with TRSDOS, ALS is for single-disk or two-disk format. Price is \$19.95, plus \$1 shipping and handling.

GB Associates, PO Box 3322, Granada Hills, CA 91344. Reader Service number 496.

## TRS-80 Speedup Program

Faster is a software speedup utility program for most TRS-80 Model I, Level II and disk BASIC programs. It analyzes executing BASIC programs, then displays or prints information that enables you to make a simple change (usually just one line). Resulting execution times are typically reduced 10–50 percent. No hardware modifications are involved.

Prosoft, Box 839, No. Hollywood, CA 91603. Reader Service number 493.

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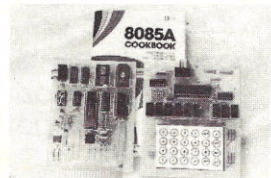
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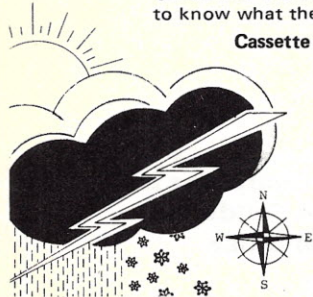
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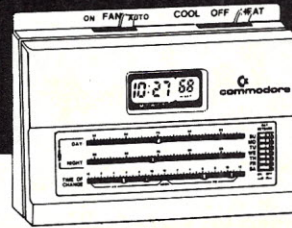
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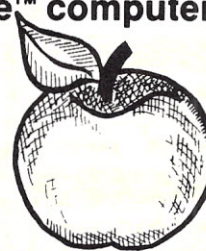
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## OSI Book Strikes Familiar Chord Getting Along with a Computer in Business Raising Computer Consciousness Intro to LoRes Graphics

### VIP, Very Important Programs for Ohio Scientific

S. Roberts  
ELCOMP Publishing, Inc.  
3873L Schaefer Avenue  
Chino, CA 91710  
Softcover, \$5.95

Oh boy! Very important programs for Ohio Scientific computers! There should be lots of utilities: line renumberer, branch finder, variable cross-reference table maker, program compactor, perhaps a simple word processor, a fix for the error code display, maybe an enhanced line editor.

Well, one person's "very important" is another's "somewhat useful." Not one of the above programs is in the book. However, the loss to OSI users may be a gain for others. All of the 45 programs are in BASIC and most are not at all limited to OSI machines.

Ten of the programs are games, mostly of medium length (about 100 lines). Although I have not seen these particular games before, they follow familiar models.

A section called "Useful Programs" contains such things as a memory test and a hex dump. The section on personal utilities has short programs like "Dollar Converter" (to German marks) and "Speed vs. Gasoline Consumption."

The longest section, and the one containing the highest-quality programs, is called "Useful Math Routines." Among them is a set of matrix programs of various types (for matrices up to 5 x 5 in size), Simpson's rule for integration, histograms and regression analysis. The longest of these is a Prey-Carnivore coupled differential equations program, about 150 lines long, using the Runge-Kutta method.

Now, I must comment on a discovery, but I don't quite know how to put it. As I

was reading page 22, my eye caught the sentence "Thoughts of a BASIC statement  $X = \text{USR}(Y)(Z)$  should be jumping into your head about now." This distinctive idea is word-for-word out of *The (Real) First Book of OSI*, by Jim Williams and George Dorner, or its precursor, both published by Aardvark Technical Service. The list of addresses this sentence is embedded in seem also to be from the precursor, but my copy of *VIP Programs* is defective here and I can't be sure.

In any case, this discovery took the edge off the surprise I experienced when I reached page 81, entitled "POKE AND PEEK," and found it was word-for-word from my own (copyrighted) book *All About OSI BASIC in ROM*, first edition, pages 16 and 17. If imitation is the most sincere form of flattery, being copied without proper attribution generates a somewhat different emotion. I am glad that information about the OSI complex is being widely distributed, but would hope that all concerned give proper credit to the originators for material used.

"But," you say, "your work is protected by copyright." Yes. For that matter so is *VIP Programs*, by Mr. Winfried Hofacker. All a copyright does is provide a license to sue. I am not at war with anyone; I just want to produce good and useful output and expect that reasonable rewards will be returned by honest users of my work.

In the same vein, the writer(s) of these programs now have a vehicle, in this book, that disseminates their work to potential users. Because of the scattered subject matter of these programs, I cannot recommend it at this price (\$9.95) to any one user. But it should be stocked at computer stores, and browsers may find some programs that meet their needs and make the book worth the price.

Edward H. Carlson  
Okemos, MI

### The Small Computer in Small Business: A Guide to Selection and Use

Brian R. Smith  
The Stephen Greene Press, 1981  
143 pp., \$12.50

There are over ten million small business owners in the United States, and many of them would like to know whether a small computer could save them money and, if so, how to go about getting one. Any book that can successfully answer these questions could sell not only a lot of copies, but a lot of computers as well.

Brian Smith's *The Small Computer in Small Business* almost makes it. Subtitled "A Guide to Selection and Use," the book is written not for the experienced business person but the computer novice. Its nine chapters include not only an introduction (albeit brief) to computers, peripherals and software, but key points for judging cost effectiveness, planning for the computer's arrival and—should all else fail—doing without.

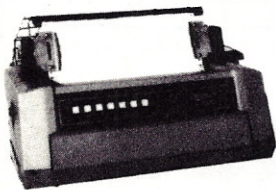
There is also a list of probing questions to ask other computer owners (and eventually the salespeople), along with warning symptoms of that dread disease, computer fever. A six-page glossary, conveniently keyed to boldface in the text, defines many of the common terms of computerese.

Author Smith is a business consultant and, not unexpectedly, the best chapters in the book relate to business applications. The 38-page discussion of packaged programs, ranging from general ledger through payroll to word processing, is liberally illustrated with sample input/output as well as with pages reproduced from typical software manuals. It is hard to imagine a better introductory treatment.

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discussion of specific hardware is already obsolete on day of publication, he confines his discussion to general characteristics and criteria for choice. Alas, the naive reader is likely to emerge without much idea of the difference between IBM's System/3 and the products down at the local computer store (indeed, nearly all the equipment pictured in the book is traditional mini, not microcomputer, gear).

The selection of topics also is a bit odd in some places. It is doubtful that the average business person desires or needs to know the details of a half-adder circuit. Why is the language C mentioned when RPG, more common in the business environment, is not? Winchester technology, program security, licensing agreements, the limitations of BASIC as a business language and the usefulness of source code for program modification are not mentioned.

Finally, the author's veneer of computer expertise wears thin at times. Definitions of byte, bus, add time and macro; the number of sectors on a floppy disk and the number of bits in 64K; and an example of FORTRAN code are all either wrong or misleading.

Within these limitations, however, this book has a lot to recommend it. Combined with a subscription to *Microcomputing* and visits to a few good computer stores, it could help a small business owner make the right choices.

**Jon Kapecki**  
Rochester, NY

## Computer Consciousness: Surviving the Automated 80s

H. Dominic Covvey and  
Neil Harding McAlister  
Addison-Wesley Publishing Co., 1980  
Softcover, 212 pp., \$5.95

This unpretentious little volume, part of Addison-Wesley's Joy of Computing series, is a pleasant change of pace from the oh-wow intros currently stuffing the book stalls.

The authors avoid the high-tech hard-sell approach so commonly adopted by today's hyper-effervescent computer futurists in favor of a more reasoned and cautious perspective. Rather than discuss the boundless and fantastic potentials of the computer, they focus on its limitations, and thus give a much more realistic idea of what the computer can and can't do.

The book tackles the problem of over-enthusiasm early. "If we think of the computer as the ultimate vehicle to transport us into the future, then we may blindly climb aboard this technology as an agent of progress without knowing precisely where we want it to take us," they warn. "If we feel that the computer represents the pot of gold at the end of the

scientific rainbow, then its existence will soon become an end in itself, and the focus of work that requires assistance from automation will shift insidiously from the original topics of investigation to research on the computer system itself. If we covet the computer as a modern philosophers' stone capable of transmuting base data into valuable information without human thought, then we will waste our time on fruitless electronic alchemy. If the computer is in our minds a conspicuous status symbol of the scientific and business communities, then we will spend a lot of money on meaningless trinkets. If we view the computer as the ultimate toy, then in childish glee we will play with this technology, frittering away time and energy on 'gee-whiz' applications of no real significance."

Later in the book, the authors draw upon the history of technology to point out that we have a tendency to be overly optimistic. They recall the days after World War II when the popular press provided us with visions of chrome-and-plastic cities in the clouds, and counsel that we don't make the same mistake with computers.

"In system development the tendency of the human mind to leap in a single bound from lowly reality to an idealized concept without considering the boundary between them is a reef on which many a computing project has foundered," they say.

The authors use their reflections as a backdrop for a clear and concise discussion of what a computer is and how it works. They aim their material at the nontechnical computer user, covering all of the usual ground—hardware, software, communications devices, programming languages and so on. The book contains no complicated schematics, but includes a number of simple and informative charts and illustrations.

One of the most helpful chapters is entitled "The System in Situ," subtitled "Computer Systems in the Human Environment." Here the authors take the reader step-by-step through the process of setting up a computer system, again emphasizing a thorough understanding of a computer's real abilities.

"It is not easy to implement any worthwhile computer system," they caution. "A rapid and painless transition may mean only that the computer system being introduced is so unimportant that it has no discernible effect on its environment."

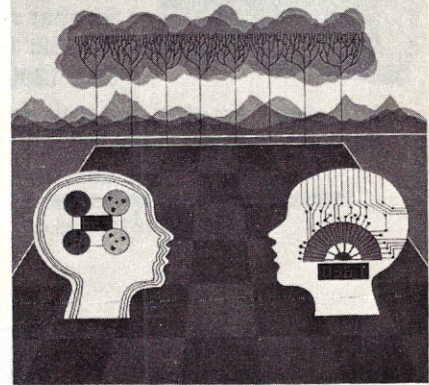
Seasoned computerists won't have much use for this book, but it is worth the time of anyone who is thinking about getting a computer, or who would like to take the first steps toward computer literacy. It would make an excellent high school or college text for any number of nontechnical sociology, science and communications classes.

The computer world could use a few

## Computer Consciousness

SURVIVING THE AUTOMATED 80s

H. DOMINIC COVVEY • NEIL HARDING McALISTER



more books written by people who aren't awed by the wonder of it all. *Computer Consciousness* is an excellent model.

**Eric Maloney**  
Microcomputing staff

## Introduction to Low Resolution Graphics

Nat Wadsworth  
Scelbi Computer Consulting, Inc.  
Elmwood, CT, 1979  
Paperback, 77 pp., \$9.95

Many microcomputers have low-resolution graphics. Yet, their owners don't know how to use this ability, or even that it exists. For these people, this book is a clear, concise and lively introduction.

Wadsworth starts with the fundamentals. Using a hypothetical 16 x 16 display matrix, he shows how the display is divided into tiny squares (pixels), which can be illuminated and turned off independently by a program. He then explains how Cartesian coordinates can be manipulated and used with graphics displays. Finally, he devotes chapters to creating simple shapes, drawing a line between any two points, and making the computer display what the computerist wants it to.

The book explains, in detail, how to control the graphics on the Apple, TRS-80 and PET using BASIC. Wadsworth initially supplies program listings for all three computers, later including only Apple listings along with a brief explanation of how they can be modified for the other two systems.

Chapter five, "A Graphics Library," includes a program that draws a winking, smiling, pointing animated clown. Wadsworth shows how to add sound, so that the clown beeps and buzzes as it winks and opens its mouth. In another example, a series of subroutines draws the individ-



ual cards in a deck. These subroutines, in combination with some of the BASIC card games now available, would make excellent game programs.

The book includes, as its final sample program, an animated football game, similar to Mattel's handheld one. The players are shown as stick figures instead of as blinking lights. They run, have audible footsteps, open their mouths and growl, and are squashed when tackled. Wadsworth provides the complete program listing for the Apple, and several tables to help TRS-80 and PET owners modify it. If you don't want to work out the modifications, you can send in a coupon for the TRS-80 and PET listings. You can also get an Apple program to draw the colorful windmill scene on the book's cover.

My primary criticism of the book concerns the lack of modified ready-to-run program listings for the PET and TRS-80. Since the book is an introduction, why is the reader expected to be able to modify a program he might not understand?

TRS-80 owners need make only minor modifications. But the commands for controlling graphics on the PET are very different. In addition, if you use the method explained here (using each character cell as one pixel), the resolution of the PET is only 40x25, compared to 128x48 for the TRS-80 and 40x40 for the Apple. Wadsworth could have used PET's block graphics set, in which each character cell is divisible into four individually controllable blocks, to increase its resolution to 80x50.

Perhaps a program to do this would have been beyond the scope of the book. Nevertheless, the lack of program listings for PETs makes the book much less useful for PET owners.

My second complaint involves the price—\$9.95. Although the book is 77 pages long, much of this is taken up by wide margins and large diagrams.

But when all is said and done, *Introduction to Low Resolution Graphics* is an excellent work. I recommend it to anyone who wants to fully use the graphics abilities of his microcomputer.

**Gary Sabot**  
**Roslyn, NY**

## The Programmer

A Novel by Bruce Jackson  
Doubleday & Company, Inc.  
Garden City, NY  
Hardcover, 281 pp., \$8.95

Eddie Argo works as a computer programmer for the city of Buffalo. Eddie's ho-hum job is only matched by his ho-hum life with a ho-hum wife.

Then his credit rating gets marred by a computer error at a large department store. Eddie decides it's time to fight oversight with program might.

He begins with a computer fix of his

wife's parking ticket. He takes on a new identity: Craig Hemsworth, the Computer Bandit. No system anywhere can match this electronic Robin Hood. Eddie plays with the FBI, IRS and American Express files, striking blows for both Eddie and the masses. Even staunch politicians find their private funds fiddled with.

Life is now anything but boring for Eddie, in his van equipped with a portable computer terminal, a blue box and a CB radio. Meanwhile, FBI agent Francis Kelly becomes more perplexed at the growing number of UCIs (unexplained computer incidents). It couldn't be Eddie—the computer says he is dead.

*The Programmer* will provide you with some delightful hours of reading. But sorry—it's not a how-to book.

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# PERSPECTIVES

(continued from page 226)

just complaints. Maybe it's because once users put forth the tremendous mental effort required to get the hang of things, they feel complacent and satisfied. They no longer have the aggravation driving them into actually writing a letter to the editor. An article is still more difficult to hurdle.

**Barry David Brown**  
**President**  
**The Datak Corporation**  
**Sparks, NV**

## Satisfied Customers

From my own experience things are not quite as bad as you would have your readers believe ("Word Processor Woes," p. 7, November 1980). Aspen Computer Service, Inc., is a service bureau which began business in 1974 with a Burroughs L8400 minicomputer. In 1977, in addition to our service bureau work, we became a dealer for The Digital Group (which went out of business in 1979). We now use four 50K Digital Group computers with dual single-sided, single-density disk drives, and two 300 LPM model 40, Teletype printers.

We are currently billing about \$6000—\$9000 a month in services and are not selling any hardware. We employ two full-time computer operators, and one part-time. We have written our own software with which we are very satisfied.

Our initial programs were written in Administrative Systems, Inc., OPUS II, which is a block structured extended BASIC. The object programs are semi-compiled. We are now writing our programs in Pascal (Michael Lehmanns: Pascal/MT), which is compiled. We are very impressed with the operating speed. As a basis of comparison, the sorting of 1000 128-character records under OPUS II takes about 75 minutes; under Pascal about two minutes. The printing of a payroll check under OPUS II (with all the reading, calculating, updating and writing) takes about 20 seconds; under Pascal about five seconds. We are in the process of rewriting all our systems in Pascal.

Comparing our Burroughs L8400 to our DG systems, we have found that the latter outperforms Burroughs in programming ease, printer speed, price and maintenance cost.

So here you have a business using microcomputers successfully and happily!

**Don A. Voltmer**  
**President**  
**Aspen Computer Service, Inc.**  
**Aspen, CO**

✓ Reader Service—see page 210

Microcomputing, April 1981 225



## Some Like It Not Some Like It a Lot

## Three Views On Word Processing

### Paradoxical Processing

Your comments about word processing in the November issue ("Word Processor Woes," p. 7) touched one of my nerves, resulting in these comments. Several months ago my office took delivery of an NBI 3000 Word Processing System. This electronic phenomenon has produced more paradoxes than I possibly could have foreseen. For example:

The system produces documents of unbelievable quality, mostly due, however, to the excellent Diablo printer.

The turn-around time for a normal two-page proposal letter, from dictation to final document, has not decreased, but rather has almost doubled.

Both my secretary and I appreciate the freedom associated with the easy editing and correction capabilities, which has resulted in more relaxed and productive dictation and transcription sessions.

The operator's guide is well written, and my secretary was able to become quite proficient on the system in a short time. But the guide serves more as a training guide, rather than a reference manual. Consequently, finding how to do something that isn't done very often is difficult and time consuming.

Every letter now goes through a "draft" stage, whereas many letters used to get typed only once, and then signed and mailed.

Many difficult typewriter functions, such as centering, lining up columns of numbers, aligning decimal points, printing equations and producing outlines, have been simplified to a few keystrokes on the word processor. This, however, is offset by the fact that many easy typewriter functions, such as the "hanging indents," have become more complicated or time consuming.

My secretary likes the idea of using a word processor, but has found that it doesn't replace a typewriter, which is still needed for many pre-printed forms or



short notes.

The confounded machine picks the absolutely worst times to fail. It always happens at 3 PM as the almost-final draft of a 12-page document (that must be mailed today) is being printed.

The machine, as with most word processors on the market today, is too large to fit on the typewriter table of my secretary's desk. We had to get a special typewriter desk extension built.

We have used the word processing system to put together a rather professional-looking newsletter, as well as to do some mass mailings with personalized letters. In both of these applications, the system has greatly simplified the task.

While the list could go on, I think it sufficiently expresses my frustrations. I am pleased with the professional quality that word processing lends to my correspondence and documents. I like the flexibility that word processing offers. I think the per-station costs are too high, but these will come down sharply over the next couple of years. I have a difficult time accepting the fact that while some tasks became easier, many other, more often used tasks became more cumbersome. But, no matter how well the letter is printed, regardless of the technology used to produce the document, in spite of the time and effort invested, the Post Office will still manage to lose it, mis-deliver it or destroy it!

**Roland K. Smith**  
Datapoint Eastern Region  
Sales Manager  
Cleveland, OH

### Satisfaction Supreme

In light of your less than satisfactory experiences with word processing ("Word Processor Woes," p. 7, November 1980), I thought I'd answer your feedback request and give you the benefit of hearing from one who is supremely satisfied with the system he bought.

I purchased an Alpha Micro AM-1031 computer system with a Qume KSR printer and a Micro-term MIME-2A CRT. I forked over about 21 kilobucks, which is a bit more than the average hobbyist can handle. The main lump in my cost is the Control Data 9427H "Hawk" hard disk cartridge drive. A serious hobbyist could buy a moderately priced AM-100 CPU system with all of the available AM languages and utility programs, but hooked up to a floppy or Winchester storage unit, an Anadex or Paper Tiger and a Soroc IQ-120. This system should come in under \$10K.

It took me about two intensive and sometimes heartbreaking days to learn the rudiments of VUE, Alpha Micro's text editor program, and I was then on my way. I've come a long way since then and am now completely at home with the system.

The only thing that I found painful about the AM system was that their manuals all assumed that you knew quite a bit about computers and the operating characteristics of large (IBM, DEC) computing systems. The AM is, I later found out, set up just like those big-boy mainframe systems. If you have had a thorough grounding in big system operation, you'll have no problem adjusting to the Alpha Micro system. The only equipment failure I had was a 7805 regulator and two switching regulator transistors in my QUME printer.

You've mentioned that you get very few letters or articles from satisfied users,

(continued on page 225)



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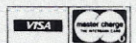
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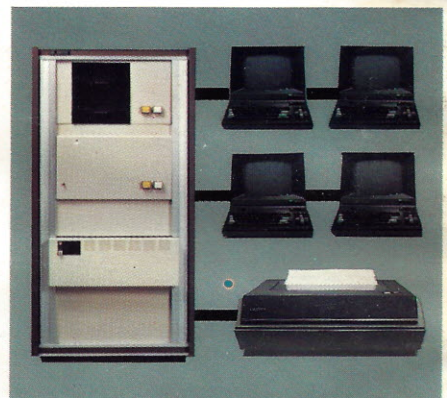
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